UNITED STATES. CIRCUIT COURT. NORTHERN
DISTRICT OF NEW YORK.

N. J. Patent Co. & National
Phonograph Company
vs.
George G. Snowden, James H.
Snowden & Henry McSweeney
doing business ... under
the name ... Indestructible
Phonographic Record Company

In Equity.
on letters
patent no.
713,209

COMPLAINANTS' RECORD ON FINAL HEARING

Note: This suit never went to final hearing ∴ this printed volume was not filed. Copies were found at ENHS.

IN THE

United States Circuit Court,

NORTHERN DISTRICT OF NEW YORK.

NEW JERSEY PATENT COMPANY
AND
NATIONAL PHONOGRAPH COMPANY,
Complainants,
vs.
GEORGE G. SNOWDEN, JAMES H. SNOWDEN and HENRY McSWEENEY, doing business as a co-partnership under the name and style of the Indestructible Phonographic Record Company,
Defendants.

In Equity. 1240
On Letters Patent No. 713,209.

COMPLAINANTS' RECORD ON FINAL HEARING.

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MELVILLE CHURCH, Esq.,
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Of Counsel.

C. G. Burgoyne, 72 to 78 Spring Street, New York.

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In the United States Circuit Court,

NORTHERN DISTRICT OF NEW YORK.

2

NEW JERSEY PATENT COMPANY and
NATIONAL PHONOGRAPH COMPANY,
Complainants,

vs.

GEORGE G. SNOWDEN, JAMES H.
SNOWDEN and HENRY MCSWEENEY,
doing business as a co-partnership under the name and style of
the Indestructible Phonographic
Record Company,
Defendants.

In Equity on
Letters Patent
No. 713,209.

3

TO THE HONORABLE THE JUDGES OF THE CIRCUIT COURT OF THE UNITED STATES FOR THE NORTHERN DISTRICT OF NEW YORK:

New Jersey Patent Company, a corporation created, organized and existing under and by virtue of the laws 4 of the State of New Jersey, and having its principal office at West Orange, County of Essex in said State, and National Phonograph Company, a corporation created, organized and existing under and by virtue of the laws of the State of New Jersey, and having its principal office at West Orange, County of Essex in said State, both citizens of the State of New Jersey, bring this, their bill of complaint against George G. Snowden and Henry McSweeney, both citizens and residents of the State of Pennsylvania, and James H. Snowden, a citizen and resident of the State of Indiana, co-partners, doing business under the name and style of the Indestructible Phonographic Record Company, and having jointly a regular and established place of business at No. 226-236 Hamilton Street, in the City of Albany and State of New York, within this District, wherein some of the acts of infringement hereinafter complained of were committed.

And thereupon your orators complain and say:

1. That heretofore and before the 5th day of March, 1898, Thomas A. Edison, being then as now a resident of Llewellyn Park, West Orange, in the County of Essex and State of New Jersey and a citizen of said State, was the original, first and sole inventor of a certain new and useful improved process of duplicating phonograms, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application for a patent therefor in this country, as hereinafter set forth, and not in public use or on sale in this country for more than two years prior to his said application, and which had not been abandoned, and which invention or improvement was not first patented or caused to be patented by the said inventor or his legal representatives or assigns in a foreign country upon an application filed more than seven months prior to the filing of the said application in this country.

2. That the said Edison, being as aforesaid, the original, first and sole inventor and discoverer of the said improved process of duplicating phonograms, made application in writing to the Commissioner of Patents of the United States for the grant of Letters Patent therefor, and paid into the Treasury of the United States the fees required by law, and then

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and there fully and in all respects complied with all
the necessary conditions and requirements of the statutes
of the United States in such case made and provided.
And thereupon, due examination having been
made by the Commissioner of Patents as to the novelty
and utility of the said invention as provided by
law, the Commissioner of Patents caused to be issued
to the said Edison Letters Patent in due form of law
under the seal of the Patent Office of the United
States, signed by the Commissioner of Patents and 10
bearing date the 11th day of November, 1902, and
numbered 713,209 ; and that the said Letters Patent
did grant unto the said Edison and unto his heirs and
assigns for the term of seventeen years from the date
thereof, the exclusive right to make, use and vend the
said invention throughout the United States and the
territories thereof, as by reference to said Letters
Patent or to a duly authenticated copy thereof, ready
in Court to be produced, will more fully and at large
appear. 11

3. That on or about the 16th day of December, 1902,
the said Thomas A. Edison by an instrument in writing,
bearing that date duly signed and delivered,
and recorded in the United States Patent Office on
the 18th day of December, 1902, in Liber D 66,
p. 473 of Transfers of Patents, did sell, assign
and transfer to your orator, National Phongraph
Company, its successors or assigns, the entire
right, title and interest in and to the aforesaid 12
invention and Letters Patent, with all rights of
action, claims and demands for damages or profits
which he had, has or may have for past infringement,
and full right to sue for and collect the same, as by
reference to said instrument or to a duly authenticated
copy thereof, ready in Court to be produced, will more
fully and at large appear. And that, further, on or
about the 28th day of March, 1906, your orator, National
Phonograph Company, by an instrument in writing
bearing that date duly signed and delivered, and

13 recorded in the United States Patent Office on the 31st day of July, 1906, in Liber V. 74, page 200 of Transfers of Patents, did sell, assign and transfer to your orator, New Jersey Patent Company, its successors or assigns, the entire right, title and interest in said invention and Letters Patent with all rights of action, claims or demands for damages and profits for past infringement which it had, has or may have, with full right to said assignee to sue for 14 and collect the same, as by reference to said instrument or to a duly authenticated copy thereof ready in Court to be produced will more fully and at large appear.

4. That your orator, New Jersey Patent Company, has been, since the 28th day of March, 1906, and is now, the sole and exclusive owner of the said Letters Patent No. 713,209, and of all claims for infringement and violation thereof; that on or about the 15 28th day of March, 1906, your orator, New Jersey Patent Company, granted unto your orator, National Phonograph Company an exclusive license under said patent for the manufacture, use and sale throughout the United States and its territories of cylindrical phonograph records made in accordance with the invention covered by said patent; that your orators, New Jersey Patent Company and National Phonograph Company have been and are, save for the doings of the said defendants and others 16 acting in concert with them, in the exclusive possession of the said rights and privileges, and are entitled to the exclusive use, benefit and advantage of the said invention and improvements.

5. That the said invention described in the said Letters Patent No. 713,209 is of great commercial value and practical utility and has been introduced into extensive public use by your orators; that your orators have spent large sums of money in manufacturing and introducing phonograph records made in

17

accordance with the said invention; and that your orators have at all times stood ready and still stand ready and are able to supply all public demands for the use of the said invention of the aforesaid Letters Patent.

6. That the said defendants, well knowing the premises and the rights secured to your orators as aforesaid, but contriving to injure your orators and to
deprive them of the benefits and advantages which 18
might and otherwise would accrue unto them from the
said invention, did, jointly, after the grant of said Letters Patent and before the commencement of
this suit, as your orators are informed and believe
and therefore aver, within the Northern District of New York aforesaid and elsewhere in
the United States, without the license or allowance of
your orators or either of them and against the will
and protest of your orators, and in violation of their
rights, unlawfully and wrongfully use or cause to be 19
used and are now using or causing to be used the said
improved process of duplicating phonograms, as set
forth and claimed in the Letters Patent aforesaid, and
did use or cause to be used as aforesaid, the said invention in the manufacture of phonograms; and that
they still continue so to do, and that they threaten to
continue the aforesaid unlawful acts to a large extent,
all in defiance of the rights secured to your orators as
aforesaid, and to their great and irreparable loss and
injury, by which your orators have been and still are 20
being deprived of great gains and profits, which they
might and otherwise would have obtained, but which
have been received and enjoyed by the said defendants
through their said unlawful acts and doings. And
your orators further show that they have caused notice
to be given to said defendants of said infringement
and of the rights of your orators in the premises, and
requested defendants to desist and refrain therefrom,
but that said defendants disregarded said notice and
refused to desist from said infringements and still con-

21 tinue to employ the improved process embodying said invention in the manufacture of phonograms ; and your orators further show that as to the number of phonograms which have been, by the defendants as aforesaid, unlawfully made, and as to the extent of the gains and profits received and enjoyed by them from such unlawful making, your orators are ignorant and pray a discovery thereof.

22 7. That the manufacture of phonograms by the employment of the invention set forth in your orator, New Jersey Patent Company's, Letters Patent No. 713,209 aforesaid by the defendants and their preparation for and avowed determination to continue the same in disregard and defiance of the rights of your orators, have the effect to encourage and induce others to venture to infringe said Letters Patent.

And your orators therefore pray : 23

1. That the said defendants, George G. Snowden,
James H. Snowden and Henry McSweeney, and each
and every of them, may be required by a decree of
this Honorable Court to account for and pay over to
your orator, New Jersey Patent Company, such gains
and profits as have accrued or arisen or been earned or
received by the said defendants or any of them by
reason of the said unlawful doings ; and that upon en-
tering the decree against the defendants, your Honors
24 may assess or cause to be assessed under your direc-
tion the said defendants' unlawful profits, and in addi-
tion thereto the damages sustained by your orators by
reason of the said infringement ; and that your Honors
may increase the actual damages to a sum equal to
three times the amount thereof under the circumstances
of the unlawful and unjust infringement.

2. That the said defendants, George G. Snowden, James H. Snowden and Henry McSweeney, and their servants, clerks, agents, attorneys, em-

ployees, workmen and confederates, and each and every of them, may be perpetually restrained and enjoined by the order and injunction of this Honorable Court from directly or indirectly employing the invention of the Letters Patent aforesaid in the manufacture of phonograms, and from any and all further infringement upon or violation of the said Letters Patent in any way whatsoever, and that they and each and every of them be ordered to deliver to your orators for destruction all molds and other apparatus used by the said defendants in the carrying on of said process covered by the said Letters Patent No. 713,209, and that the said defendants may be decreed to pay the costs of this suit.

3. That your Honors will grant unto your orators a preliminary injunction issuing out of and under the seal of this Honorable Court, enjoining and restraining the said defendants and each of them to the same purpose, tenor and effect as hereinbefore prayed for with regard to said perpetual injunction.

4. And that your orators may have such other and further relief as to this Honorable Court shall seem meet and as shall be agreeable to equity.

To the end therefore, that the said defendants may, if they can, show why your orators should not have the relief prayed for, and may full, true and direct answer make, but not under oath (answer under oath being hereby expressly waived), according to the best and utmost of their knowledge, remembrance, information and belief, to the several matters hereinbefore averred and set forth, as fully and particularly as if the same were repeated paragraph by paragraph and the said defendants specifically interrogated, may it please your Honors to grant unto your orators a writ of *subpœna ad respondendum*, issuing out of and under the seal of this Honorable Court, directed to the said defendants, George

29 G. Snowden, James H. Snowden and Henry McSweeney, commanding them by a certain date and under a certain penalty to be and appear in this Honorable Court, then and there to make answer to this bill of complaint and to perform and abide by such orders and decrees herein as to this Court may seem just.

And your orators will ever pray, etc.

New Jersey Patent Company,
By Harry F. Miller,
30 Secretary.
National Phonograph Company,
By Alphonse Wertee,
Secretary.

Louis Hicks,
Of Counsel and Solicitor for Complainants.
Dyer Smith,
Delos Holden,
Of Counsel for Complainants.

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31 State of New Jersey, }
County of Essex, } ss. :

Harry F. Miller, being duly sworn, deposes and says that he is the secretary of the New Jersey Patent Company, one of the complainants named in the foregoing bill of complaint; that he has read the same and knows the contents thereof to be true except as to those matters stated to be alleged on 32 information and belief, and as to those matters he believes it to be true; that the reason why this verification is not made by the complainant, the New Jersey Patent Company personally, is because said complainant is a corporation.

Harry F. Miller.

Subscribed and sworn to be-
fore me this 10th day of
August, 1909.

Anna R. Klehm,
[L. S.] Notary Public,
State of New Jersey.
Commission expires June, 1913.

33

STATE OF NEW JERSEY, }
County of Essex. } ss. :

ALPHONSE WESTEE, being duly sworn, deposes and says that he is the secretary of the National Phonograph Company, one of the complainants named in the foregoing bill of complaint; that he has read the same and knows the contents thereof to be true except as to those matters stated to be alleged on information and belief, and as to those matters he believes it to be 34 true; that the reason why this verification is not made by the complainant, the National Phonograph Company, personally, is because said complainant is a corporation.

ALPHONSE WESTEE.

Subscribed and sworn to before me this 10th day of August, 1909.

ANNA R. KLEHM,
[L. S.] Notary Public,
State of New Jersey. 35
Commission expires June, 1913.

36

37

UNITED STATES CIRCUIT COURT,
NORTHERN DISTRICT OF NEW YORK.

NEW JERSEY PATENT COMPANY and
NATIONAL PHONOGRAPH COMPANY,
Complainants,

vs.

38 GEORGE G. SNOWDEN, JAMES H.
SNOWDEN and HENRY MCSWEENEY,
doing business as a co-partnership
under the name and style of the
Indestructible Phonographic Record Company,
Defendants.

In Equity
No. 7240.
On Letters Patent No. 713,209.

Replication to Answer.

39 These replicants, saving and reserving to themselves
all and all manner of advantage of exception, which
may be had and taken to the manifold errors, uncertainties
and insufficiencies of the Answer of the said
defendants, for replication thereunto saith, that they
do and will aver, maintain and prove their said bill to
be true, certain and sufficient in the law to be answered
unto by the said defendants, and that the Answer of
the said defendants is very uncertain, evasive, and insufficient
in law to be replied unto by these repliants;
40 without this, that any other matter or thing in the said
Answer contained, material or effectual in the law to
be replied unto and not herein and hereby well and
sufficiently replied unto, confessed or avoided, traversed
or denied, is true; all which matters and things
these repliants are ready to aver, maintain and prove
as this Honorable Court shall direct, and humbly pray
as in and by their said bill they hath already prayed.

Dated December 6, 1909.

LOUIS HICKS,
Solicitor for Complainants,
71 Nassau Street,
New York City.

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UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF NEW YORK.

NEW JERSEY PATENT COMPANY and NATIONAL PHONOGRAPH COMPANY,
Complainants,

vs.

GEORGE G. SNOWDEN, JAMES H. SNOWDEN and HENRY McSWEENEY, doing business as a co-partnership under the name and style of the Indestructible Phonographic Record Company,
Defendants.

In Equity
No. 7240.
On Letters Patent
No. 713,209.

42

Present: DYER SMITH, ESQ., and MELVILLE CHURCH, ESQ., for the complainants, and WALTER A. SCOTT, ESQ., for the defendant. 43

Deposition of witnesses examined on behalf of the complainants, pursuant to notice which is hereunto annexed, at Edison Laboratory, Orange, N. J., January 11th, 1910, before Anna R. Klehm, a Notary Public for the State of New Jersey, beginning at 10.30 a. m.

STEPHEN C. PORTER, a witness produced on behalf of complainant, having been duly sworn, deposes and says as follows, in answer to questions propounded to him by Mr. Church, of counsel for complainant: 44

Q. 1. Please state your name, age, residence and occupation?

A. Stephen C. Porter, 46 years, Martinsville, N. J., Phonograph business, or talking machine business.

Q. 2. In what branch of the talking machine business are you engaged?

A. In making records vocally.

45 Q. 3. State whether or not you have at any time been interested in the production of matrices for forming what are known as gold-molded records?

> The question is objected to as irrelevant and immaterial in that the issue of this case is no way concerned with the production of matrices by gold-moulding or otherwise, but under the claims of the patent in suit is restricted to the 46 production of records from matrices regardless of the manner in which the matrices are formed.

A. In an experimental way, but never actually manufacturing them, except to demonstrate that it could be done.

Q. 4. Will you please tell us in your own way how you are interested in this project and what you did in that direction?

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> It is agreed that the objection entered to the last question apply to this and all succeeding questions in the same line of examination, without the necessity of repetition.

A. Mr. James K. Reynard came to me and represented that he had invented a process for depositing gold on cylinder master records and that he owned the right to do what he wished with it. He proposed that I follow some experiments with him at 241 West
48 23d St., N. Y. C., and I entered into an agreement with him and John O. Prescott, to carry on these experiments, Mr. Prescott and myself furnishing the money for all apparatus and necessary expenses. Mr. Prescott was to have the use of such process for the American Record Company of which he was part owner. On June 19th, 1906 I sailed to London and sold the process to Russell Hunting Record Company of London, and on or about May, 1907, I became convinced, as also did Mr. Prescott, that we were burdened with the apparatus we had and that we were

49 told that Mr. Reynard had no real rights to the invention and I met Mr. Matthews of the Indestructible Company and sold him the entire apparatus for practically cost, and installed it at their laboratory on Livingston Street in Brooklyn, N. Y.

Q. 5. In your last answer you referred to the Indestructible Company; is that the full title of the company, and if not, will you give the full title?

A. I think it is the Indestructible Phonographic Record Company. 50

Q. 6. Will you please examine sketch which I now show you and state what it represents?

A. It represents the compartment and apparatus for depositing gold on a record.

Q. 7. A sketch of what apparatus?

A. The one I sold to Matthews.

Q. 8. Before we get farther I will ask you to state what Mr. Matthews' position was with the Indestructible Phonographic Record Company?

51 A. He was the Manager of the Recording Department.

Q. 9. Now will you please describe the apparatus that you sold to the Indestructible Phonographic Record Company, as you have stated, making use of the sketch that you you still hold purporting to represent that apparatus, and referring where necessary for clearness to the numerals that are found on the sketch?

A. Essentially it was a glass cylinder, over which a glass plate was placed, which had been ground 52 carefully with the top of the cylinder; the glass cylinder rested on another glass plate, which was also ground carefully with the bottom of the cylinder. The glass cylinder is numbered 1, and the plate is numbered 2 on this sketch. Inside of the cylinder was placed a brass mandrel 4, on a brass plate 5, through which was steel spindle 6, which held the plate and mandrel, and there were holes leading through the bottom plate 3, one for the spindle 6, one for exhausting the air from the cylinder 1, and the

53 spindle passed through a nut 8, which extended through plate 3. There was a rubber gasket 9 between plate 3 and nut 8, and on the top of nut 8, which projected through plate 3, which was threaded at the upper part, a nut 10 was screwed which drew the gasket 9 closely against plate 3, thereby excluding any escape of air. A small arm 11 was inserted in spindle 6 at right angles, another arm 12 was attached to a rod 13 which was a part of a machine which rotated 54 thereby turning the arm 11, which rotated the mandrel in the cylinder 1. Steel balls 14 were placed between the nut 10 and another collar 15, on which the mandrel 4 rotated. A cup 16, which held glycerin or oil was placed on spindle 6, and kept in close contact with the nut 8, thereby preventing any air from passing into the chamber 1. Through two holes in the plate 3, two wires of platinum encased in two plugs 20 entered into the cylinder 1 and connected with an anode and cathode 24, held into position by platinum wires 55 26. The air was exhausted from cylinder 1 by tube 27, which extended through hole 7. The gold anode and cathode 24 were placed upon a strip of mica 21, through a hole 23, and turned over and hung on the platinum wire 26. The bottom was then put through a hole 22 and drawn tightly so that it would stay in as close contact as possible with the strip of mica 21. A small piece of mica 25 was placed over the spot where the platinum wire went through the overlapping piece of gold, which projected through the mica, to avoid 56 any escape of electrical current. The platinum wire 26 extended through glass tubes 19, which were connected to the plugs 20, down through the plate 3, and connected to a spark coil, which furnished the necessary electric energy for the deposit of gold.

Q. 10. In what form was the gold employed in this apparatus?

A. The gold in the chamber was two strips, each about ¼ of an inch wide, and 5 one-thousandths of an inch thick, 24 karats fine.

Q. 11. Will you now please tell us how this

57 apparatus was operated and what the result was of the operation?

A. A wax master record was put on the brass mandrel contained in the cylinder 1, and the glass plate was then placed on top of the cylinder, after having placed between them a preparation of bees wax and tallow, to prevent any escape of air; the air was then exhausted from the chamber until a vacuum was obtained or as close to a vacuum as possible. The mandrel on which the wax master was placed was then 58 rotated and the current from the spark coil turned on. If the proper amount of air had not been exhausted, a reddish light appeared, the current was then turned off and the air exhausted until it was thought a vacuum had been obtained, and the current would then be turned on again, and when a light violet ray appeared, the current was allowed to remain turned on until the proper amount of gold had been deposited on the wax record. The current was then turned off and the air allowed to enter the chamber, the top plate would be 59 removed and the wax record taken off.

Q. 12. State, if you know, how this gold film applied to the wax record was utilized after it and the wax record were removed from the apparatus you have described?

A. The gold film still adhering to the wax record, is placed in a bath, containing copper sulphate and oil of vitrol and certain proportions in which is a copper anode, and copper is then deposited on the gold film by a process known as electrotyping, until the 60 desired quantity of copper had been obtained. It is then removed from the bath and either backed by brass cylinder which is sweated on or if the deposit of copper has been sufficient, it is used without any backing.

> The question and answer objected to as irrelevant and immaterial in that the question does not appear to be directed to what defendant has done nor the answer to relate thereto. A

61 further objection is made in that it does appear that the question calls for the witness' testimony as to what he has witnessed or done himself, and, therefore, may call for his hearsay knowledge.

Q. 13. State, if you know, who installed this apparatus that you have described as having been sold to the Indestructible Phonographic Record Company?

62 A. I did.

Q. 14. When was this sale effected, and when was installation made?

A. About the month of May, 1907.

Q. 15. After the installation of this apparatus at the place of business of the Indestructible Phonographic Record Company in Brooklyn, did you or not ever see the apparatus there again, and if so, please state when?

A. About two or three weeks after I had installed
63 it, I was in Mr. Matthews's office and through a door
which was opened, I got a glimpse of the apparatus.

Q. 16. State whether or not on the occasion last mentioned, anything was said by you or by Mr. Matthews with relation to the apparatus or its working, and if so, state what was said?

The question is objected to as hearsay as to what Mr. Matthews said.

64 A. I said to Mr. Matthews "Well, how is the gold-moulding outfit that I sold you," and he said "All right."

Q. 16½. During the course of your deposition, you have used a sketch in connection with your description of the apparatus sold to Indestructible Phonographic Record Company, will you please state under whose direction this sketch was made and for what purpose?

A. Under my direction to show how the apparatus

65 was operated, which I sold to Indestructible Record Company.

Q. 17. Please state approximately when this sketch was made?

A. July 7, 1909.

> Counsel for complainant here offers in evidence sketch referred to by the witness and the same is marked "Complainant's Exhibit, Porter Sketch of Gold-moulding Apparatus." 66
>
> No cross-examination.

STEPHEN C. PORTER.

ARTHUR S. BROWNE, another witness produced on behalf of complainant, having been duly sworn, deposes and says, in answer to interrogatories propounded to him by Mr. Church, of counsel for complainant, as follows:— 67

Q. 1. Give your name, age, residence and occupation?

A. Arthur S. Browne, 49 Chevy Chase, Maryland, patent solicitor and expert.

Q. 2. Please state, what in your opinion qualifies you to testify as an expert in patent cases, and particularly in cases relating to improvements in the phonographic art? 68

A. I was graduated from Dartmouth College in 1881, and in the following year I entered my present profession in which I have since been actively and continuously engaged. I have prepared and prosecuted many hundreds of applications for patents; and I have made numerous investigations into the literature of various arts for the purpose of giving opinions concerning the novelty of inventions and the scope and validity and infringement of patents. I have

69 testified as an expert witness in more than 250 patent
suits in the United States courts. In fact, during the
last ten or twelve years, the greater part of my time
has been consumed in giving testimony and in preparation
therefor. In connection with such work, I have
frequently visited workshops and factories for practical
experience. I have testified as an expert witness
in quite a number of patent suits relating to the phonographic
art. I should say from recollection that I
70 have testified in at least ten such suits, the first
having been about fifteen years ago. As a result of
this litigation I have become familiar with the phonographic
art, both with regard its literature and with
many of the practical machines and processes involved.

Q. 3. State whether or not you have read the patent
granted to Thomas A. Edison, No. 713,209, dated November
11, 1902, and understand the process of
duplicating phonograms, set forth and described
therein, and particularly referred to in claims, 2, 3, 4,
71 5, 9, 10, 13, 16 and 17 thereof?

A. I have and do.

Q. 4. Please state what you find to be the process, shown and described in said patent and referred to in the aforesaid claims thereof?

A. The Edison patent in suit, No. 713,209, November 11, 1902, sets forth a method or process of duplicating "phonograms," that is to say, phonographic records.

To facilitate an understanding of the Edison invention,
72 I will first briefly refer to the ordinary way in
which the phonographic record is made in the first
instance.

The original sound record is cut in the surface of a cylinder of a soft material, which is wax-like in its characteristics. This soft, wax-like cylinder is mounted in a talking machine so as to be rotated. The talking machine has a diaphragm, which is vibrated in correspondence with the sounds which it receives; and, it in turn puts into vibration a cutting tool or stylus, which comes into contact with the surface of the wax cylin-

73 der. This cylinder rotates and there is also a lengthwise relative movement between the cylinder and the stylus (due either to lengthwise movement of the cylinder or lengthwise movement of the stylus), so that a spiral groove is cut in the surface of the wax cylinder. This spiral groove, however, varies in depth, owing to the vibration of the stylus under the influence of the sound waves. Accordingly, the sound groove which is cut has a circular depth, depending upon the character of the sound vibrations. This sound groove is minute 74 in its dimensions. It is customary to have the lengthwise feed of the cylinder produced by a screw having 100 threads to the inch, so that the sound groove is less than a hundredth part of an inch in width, and its average depth is much less than that.

This cylindrical sound record thus made can be used for the reproduction of the sound by being placed in a sound reproducing machine. This "reproducer" is substantially like the "recorder", except that the reproducer does not have a cutting stylus, but has a 75 "rubbing" stylus, with a rounded contour, which tracks the irregular sound groove. Accordingly, vibrations are imparted to the reproducing stylus, corresponding to those initially imparted to the recording stylus and through the diaphragm of the reproducer these vibrations are transmitted to the air, and are amplified by a horn, so that the original sounds are reproduced.

In case the sounds are to be reproduced only once, or only a few times, it is entirely feasible to use the 76 original sound records for reproducing purposes. For example, if the phonograph is used in an office for dictation purposes, the sound record has completed its office when the dictated matter has been reduced to writing. The surface of the sound cylinder can then be planed off so as to get a second smooth surface, and can be used over again for further dictation.

The phonographic art, however, has so developed that its largest utility is for amusement purposes. A great singer sings in the vicinity of a recorder or a

77 band plays a popular selection and the resulting sound
record is then utilized for the reproduction of duplicates
which can be sold to the public for use on a fit
recorder. Manifestly, if it were necessary to sell the
original sound record to a customer, the cost would be
prohibitive in the case of a popular singer or instrumental
performer. Another vital consideration is that
the material used for the original sound record is
necessarily soft to enable the sound grooves to be cut
78 therein, with the result that the record is not durable,
being rapidly distorted and worn out through the
mechanical action of the reproducing stylus. An
efficient record to be sold on the market for amusement
purposes must be capable of a large number of
repetitions in the reproducer without material deterioration.

The Edison patent in suit relates to the manufacture
of duplicate "phonograms" or phonographic records,
from a single original sound record or "master"
79 record. The patent suggests a number of modifications,
both in connection with the steps of the process
and the materials used. I will, however, describe in
detail the preferred process as set forth in the patent,
and will then direct attention to the more important
modifications. The first step in the process of duplication
is to form a metallic mold or matrix from the
original wax master record. To do this the surface of
the wax master record has deposited upon it an exceedingly
thin layer of metal, gold being the metal
80 employed. The particular method of depositing the
films of gold upon the wax master is described in detail
in another patent of Mr. Edison, No. 526,147,
dated September 18, 1894, and referred to at line 57,
page 1 of the Edison patent in suit, (there being, however,
a clerical error in the stated number of the other
patent) and to this other patent reference can be had
for a more extended description of the method of depositing
the film of gold. The important characteristics
are that a wax master record is placed within
a vacuum chamber, the gold is vaporized by an elec-

81 tric arc, and the metallic vapor is deposited as a thin uniform coating upon the master record following accurately all of the irregularities of the sound groove.

A very thin preliminary coating of metal having been thus applied to the master record, said record is then immersed in an electro plating bath, and is thereby coated with metal to a sufficient thickness to form a metallic shell or cylinder sufficiently stiff to be handled. This shell carries on its interior the original or master record, and its interior bore 82 carries an accurate negative representation of the original sound groove. In this metallic mold there is within its bore a projecting sinuous irregular rib corresponding to the engraved groove of the original master record. The electro-plated shell can then be backed in any suitable way and the original master record can be destroyed in removal. Or, as the patent states, the original record can be contracted and removed so as not to involve its destruction. The preservation, however, of the original wax record is of 83 little consequence, because the sound record now exists in the metal within the bore of the metallic matrix or mold.

This matrix or mold is then used for the indefinite multiplication of duplicate records. The same material may be used for the duplicates as in the making of the original master records, but the patent points out that a harder material is desirable for the sake of the durability of the duplicate record. The hard wax-like material is initially formed as a hollow cylinder 84 with a smooth cylindrical exterior and a slightly tapering bore, this cylinder being sufficiently thick to maintain its shape during the process. This blank cylinder has an external diameter just enough smaller than the bore of the metallic matrix to enable it to be slipped endwise into the matrix. The condition of affairs at this stage of the process is illustrated in sheet 1 of the drawings of the Edison patent in suit. Fig. 1 shows at B, the hollow cylinder of hard wax-like material, inserted within the matrix A. As shown, the matrix A

85
comprises an exterior re-enforcing cylinder to protect the electroplated shell having on its interior bore the irregular sound grooves indicated by the sinuous line in Fig. 1*a*. Fig. 1*a* is a greatly exaggerated view, showing the relation between the irregular bore of the matrix on its interior surface and illustrating the slightly less diameter of the wax-like blank. Also, as shown in Fig. 1, the matrix and the wax-like blank rest upon a ring D, having a central bore E of greater
86 diameter than the bore of the adjacent end of the wax-like blank.

A tapering mandrel C is then inserted within the tapering bore of the blank, as illustrated in Fig. 2 of the drawings, and the mold, blank and mandrel are then subject to the action of heat. The effect of the heat is to soften the material of the blank and at the same time to expand it; and, as its coefficient of expansion is greater than that of the metallic matrix or mold, the effect is to bring the blank into contact with
87 the irregular surface of the bore of the matrix.

After the blank has thus been expanded into contact with the matrix, the mandrel C is forced tightly within the blank, so as to further expand the blank by mechanical means. In this way the blank is forced in absolute intimate contact with the record carried by the matrix, and an impression is received on the blank, which is a clear sharp and absolutely faithful reproduction and duplicate of the original sound record engraved in the master record by the recording machine.

88 The mandrel is then removed from the duplicated record, and the duplicate record is then chilled, as by placing the matrix with the contained record in a refrigerating chamber. The chilling of the thus duplicated record causes it to resume its original dimensions less in diameter than the matrix (or even it may be of less diameter if the chilling is carried below the original normal temperature than the blank); and the finished record is then removed endwise from the matrix. Sheet 3 shows the chilled duplicate record

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contracted sufficiently to be removed endwise from the surrounding cylindrical matrix.

The matrix can be used indefinitely for making duplicate sound records. Accordingly with a single original sound record, duplicates can be made to an unlimited extent, thus enabling them to be economically sold, although the cost of the original records may have been very large, due to the hiring of a high-priced vocalist. At the same time, much harder material may be used for the duplicate than for the orig- 90
inal sound record, since no engraving has to be done, with the result that the duplicate records are durable and lasting and can be used for an indefinite number of repetitions. The patent in suit suggests a number of modifications. Concerning the material employed for the blanks from which the duplicates are made, the patent says :

> "These blanks may therefore be made of a
> relatively hard material, such as asphalt, or of 91
> stearic acid or stearate of soda mixed with varying proportions of fine precipitates—such as chalk, slaked lime, or lamp-black—or waxes or resins may be used, such as sealing wax or shellac mixed with fine precipitates, like chalk, or polished ebonite, vulcanized hard rubber, or celluloid may be alone used, or glue may be employed either alone or mixed with precipitates, such as chalk" (page 3, lines 8-18).

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Obviously, the degree of heat to bring the materials into a proper plastic condition for molding should be appropriate to the material employed for the blanks, as stated in the patent, which says :—

> "The degree of heat necessary to properly expand the blank will depend largely upon the material of which the blank is formed and upon the closeness of fit of the blank when inserted

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> within the matrix or mold" (page 2, lines 84–88).

The specification describes the heating alone as adequate in some cases to expand the blank sufficiently to take the duplication of the sound record; and further states that the expansion to get the sound record may be accomplished wholly mechanically. Concerning the first proposition, the specification says: 94

> "The expansion of the blank into this intimate engagement with the interior of the matrix or mold may be effected in any suitable way, such as by maintaining the matrix or mold, with the blank contained therein, in a heated atmosphere "(Page 2, lines 28–33).

Concerning the accomplishment of the expansion of the blank solely mechanically, the specification says:— 95

> " With blanks of sufficiently viscous material the entire expansion may be effected mechanically by forcing a tapering mandrel within the same " (Page 2 lines 53–56).

Also, although the production of the matrix by electro-plating on a master covered with a film of deposited metal is described as the preferred method of making the matrix, and is specified in some of the claims, the specification says:— 96

> " Instead of coating the original record with a vaporized metal it may be coated with a very thin layer of specially prepared plumbago of exceedingly-great fineness, or instead thereof gold-leaf or silver salts reduced by chemical re-agents to the metallic state may be used for the same purpose " (Page 1, lines 68–75).

97 The claims referred to in the question define the described process with varying degrees of comprehensiveness. I think all of the claims will be at once intelligible on reading, but as indicating their varying comprehensiveness, I will, at this point quote claims 5 and 16, which are respectively comprehensive and detailed.

> "5. The method of producing phonograms which consists in placing within a hollow cylindrical record-matrix a hollow cylindrical phonographic blank of sufficient thickness to maintain its form under normal conditions, softening said blank by heat and expanding the same while heated so as to take the record from the matrix, shrinking the phonogram so made by change of temperature, and withdrawing the same from the matrix by direct longitudinal movement." 98
>
> "16. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing in a vacuum a metal vapor upon the original phonogram, electroplating a metal thereon so as to form a matrix or mold, in inserting the continuous cylindrical blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth." 99 100

Adjourned to Wednesday, January 12, 1910, at 10 a. m.

101

JANUARY 12, 1910.

Met pursuant to adjournment.

The testimony of the witness ARTHUR S. BROWNE, is continued.

Q. 5. We will assume that the defendants herein first take a cylinder of wax or wax-like material, bearing on its peripheral surface a sound record to
102 be duplicated, the same being commonly known as a master record; then make a vacuous deposit of gold upon the entire record surface of the said master record to form a thin gold film matrix, having a negative impression of the record upon it; then re-enforce the film of gold by electroplating a backing of copper or other metal upon it; then remove the original wax master from the gold lined matrix by melting, shrinking, or breaking it out; then place the matrix in an apparatus called a printing machine; then place in
103 the matrix a celluloid blank in the form of a hollow cylinder having an inwardly extending flange at each end, said cylinder being of sufficient thickness to maintain its shape under normal conditions and during and after its engagement with the matrix, the diameter of said blank being slightly less than that of the bore of the matrix; then close the top and bottom of the matrix; then introduce steam under a pressure of about 50 pounds into the matrix, so as to cause the
104 blank to be softened and to be expanded into contact with the matrix, the inturned ends of flanges of the blank sealing the space within the record cylinder hermetically; then turn off the steam and introduce into the interior of the record, compressed air at a pressure of about 80 pounds; then cool the matrix and cylinder therein till the cylinder shrinks away from the walls of the matrix; and then withdraw the record cylinder from the matrix by a direct longitudinal movement.

Now on the above assumption, please compare the

105 process or method so assumed to be practiced by the defendants, with the process or method of the Edison patent No. 713,209 in suit, as particularly referred to in claims 2, 3, 4, 5, 9, 10, 13, 16 and 17 of said patent, and state the result of such comparison?

A. The defendants' process as described in the question, is the process of the Edison patent in suit as defined in the claims mentioned; and differs from the specific process set forth in the Edison patent only in details which are of no consequence so far as the subject matter of the stated claims is concerned. 106

In comparing the defendants' process with the several stated claims of the Edison patent in suit, I will first consider the broad and specific claims 5 and 16, just quoted by me, and then will consider the other claims.

Claim 5 of the Edison patent recites a "method of producing phonograms," that is to say, phonographic records capable of use for reproducing sound, and this is what defendants' method does. Claim 5 states that this method consists of a series of steps which I will analyze as follows: 107

(1) "Placing within a hollow cylindrical record-matrix a hollow cylindrical phonograph-blank of sufficient thickness to maintain its form under normal conditions." Defendants do this. They make a hollow cylindrical metallic record matrix by the steps of making a vacuous deposit of gold and then re-enforcing the film of gold by electroplating a backing of metal upon it. They place within this a hollow cylindrical phonograph blank of celluloid (one of the materials mentioned by Edison at line 16, page 3) and there is enough substance in this celluloid cylinder so that it is of sufficient thickness to maintain its shape under normal conditions. Accordingly, defendants perform this step of claim 5. 108

(2) "Softening said blank by heat and expanding the same while heated so as to take the record from the matrix". Defendants do this. They subject the celluloid blank to the action of steam under a pressure

109 of about 50 pounds, and hence an amply sufficient temperature to soften the celluloid and render it sufficiently plastic to readily take an impression. The combined heat and pressure first of the steam and afterwards of the more highly compressed air expand the blank in the heated condition so that the blank is forced into intimate contact with the bore of the matrix with the inevitable and necessary result that the phonographic characters are printed or impressed upon the
110 outer surface of the celluloid cylinder. Accordingly, defendants perform the second step recited in claim 5.

(3) "Shrinking the phonogram so made by change of temperature". Defendants do this. In accordance with the description contained in the question, defendants "cool the matrix and cylinder therein till the cylinder shrinks away from the walls of the matrix". This is the effect of the cooling of the celluloid cylinder, since it was small enough in its original condition, to enable it to be placed within the cylindrical
111 matrix. Accordingly, defendants perform this step of claim 5.

(4) "Withdrawing the same from the matrix by direct longitudinal movement". Defendants do this. The description in the question states that defendants "then withdraw the record cylinder from the matrix by a direct longitudinal movement". Accordingly, defendants perform this step of claim 5.

These are all of the recitations of claim 5 and they all apply to the defendants' process. The claim is
112 just as apt when applied to the defendants' process as it is to the specific process set forth in detail in the Edison patent. Defendants use celluloid for the blank, which is one of the materials specified by Edison. While Edison specifically describes placing the matrix and blank in a heated atmosphere and expanding the heated blank by a tapering mandrel, in addition to the expansion obtained by the heat; and while defendants get the same results by heating with steam, and expanding by the heat and pressure of the steam and by the subsequent air pressure; nevertheless,

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claim 5 does not specify the detailed way of heating and mechanically expanding, but simply states that the blank is softened by heat and expanded while heated so as to take the record from the matrix, and this is just what the defendants do. Accordingly, these specific differences are of no consequence so far as the subject matter of claim 5 of the Edison patent in suit are concerned. Therefore, defendants' method is the method of claim 5 of Edison.

Claim 16 of the Edison patent in suit calls for a 114 "process of duplicating cylindrical phonograms having a phonographic record thereon," and this is likewise the process of defendants. The several steps of the process of claim 16 are shown in the following analysis:

(1) "Depositing in a vacuum a metal vapor upon the original phonogram." Defendants do this. The question says that defendants "make a vacuous deposit of gold upon the entire record surface of said master record, to form a thin gold film matrix, having a negative impression of the record upon it," and this 115 is what this step of the process of claim 16 calls for.

(2) "Electroplating a metal thereon so as to form a matrix or mold." Defendants do this. The question says that defendants "then re-enforce the film of gold by electroplating a backing of copper or other metal upon it." This necessarily results in forming a matrix or mold. Hence, defendants perform this second step of claim 16.

(3) "Inserting the continuous cylindrical blank to be reproduced within said matrix or mold." Defendants 116 do this. In accordance with the question, they "place in the matrix a celluloid blank in the form of a hollow cylinder." It is upon this blank that the sound record is reproduced while within the matrix or mold. Accordingly, defendants perform this step of claim 16.

(4) "Expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix." Defend-

117 ants do this. In accordance with the question, they "introduce steam under a pressure of about 50 pounds into the matrix, so as to cause the blank to be softened and to be expanded into contact with the matrix, the inturned ends of the flanges of the blanks sealing the space within the record cylinder hermetically," and then the steam is turned off and defendants "introduce into the interior of the record compressed air at a pressure of about 80 pounds." As the inevitable
118 and necessary result of this heat and pressure, the blank is expanded into intimate engagement with the record in relief carried by the bore of the matrix as here called for by claim 16. The question states that the celluloid blank is "of sufficient thickness to maintain its shape under normal conditions and during and after its engagement with the matrix" so that the blank has the characteristics here called for by claim 16. Hence, defendants practice this step of claim 16;

119 (5) "Finally removing the cylinder by direct longitudinal movement." Defendants do this. The question says that defendants "then withdraw the record cylinder from the matrix by a direct longitudinal movement." Therefore, defendants perform this step of claim 16.

These are all of the recitations of claim 16, and they all apply to defendants' process. Defendants perform the process called for by this claim on one of the materials specified in the patent and to get the same re-
120 sults.

The remaining claims referred to in the question fall into two groups, of which claims 5 and 16 already discussed, are typical. Each of claims 9, 10, 13 and 17 include the formation of the matrix or mold by depositing metal on the original phonogram or master record; but this is not specified in claims 2, 3 and 4.

I will consider these additional claims in their numerical order.

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Claim 2 is as follows:

> "2. The method of producing hollow cylindrical phonograms, which consists in obtaining a mold having a reverse phonogram-record on the inner wall of a cylindrical opening, forming a hollow cylindrical plastic phonogram within said mold, releasing the phonogram from the mold by a radial contraction of the phonogram sufficient to entirely clear the surfaces, and removing 122 the phonogram from the mold by direct longitudinal movement."

A perusal of this claim with the defendants' method will at once show its applicability thereto. In accordance with this claim, the mold or matrix having a reverse phonogram record on the inner wall of its cylindrical bore can be obtained in any way; and the duplicate hollow cylindrical plastic phonogram may be formed within the matrix or mold in any way. Hence, 123 defendants' ways of making the mold and the duplicate phonogram come within these recitations. Plasticity is a notable property of celluloid when heated, so that the celluloid phonograms of defendants is hollow, cylindrical and plastic, as called for by claim 2. The claim requires that the phonogram should be released from the matrix or mold "by a radial contraction of the phonogram sufficient to entirely clear the surfaces" of the mold and of the phonogram. This radial contraction is an inevitable result of the cooling off defendants' 124 celluloid phonogram subsequent to its being heated and expanded. The final recitation of the claim is that the phonogram is removed "from the mold by direct longitudinal movement," and the question specifically states that defendants do this. Accordingly, defendants practice the process of claim 2, since they perform all of its steps and get the same results as called for by the Edison patent.

125 Claim 3 is as follows:

> "3. The method of producing hollow cylindrical phonograms which consists in obtaining a mold having a reverse phonogram-record on the inner wall of a cylindrical opening, forming a hollow cylindrical plastic phonogram within said mold, releasing the phonogram from the mold by a reduction in temperature sufficient
> 126 to entirely clear the surfaces, and removing the phonogram from the mold by direct longitudinal movement."

This claim is just like claim 2, except that this claim states that the phonogram is released from the mold sufficient to entirely clear the surfaces "by a reduction in temperature," instead of by a "radial contraction" as in claim 2. This different statement of claim 3 applies to defendants' method, since release of the
127 phonogram from the mold is due to the contraction of the phonogram, as the result of the cooling of the phonogram. Accordingly, defendants practice the method of claim 3.

Claim 4 is as follows:

> "4. The method of producing phonograph-cylinders which consists in placing within a hollow cylindrical record mold or matrix, a hollow cylindrical phonograph-blank of suffi-
> 128 cient thickness to maintain its shape during and after its engagement with the matrix, outwardly expanding such blank against said matrix, disengaging the impressed record-cylinder from the matrix, and withdrawing said record-cylinder from the matrix by direct longitudinal movement."

This claim, so far as the characteristics of the blank, the mold or matrix, the placing of the blank within the matrix, and the final withdrawal of the completed

129 record from the matrix, are concerned, is substantially like claim 5 already considered. With respect to the taking of the impression on the record by the blank, and the disengagement of the impressed record from the matrix, claim 4 is more comprehensive than claim 5. In these respects, claim 4, calls for "outwardly expanding such blanks against such matrix" which defendants do by heat and pressure; and then "disengaging the impressed record cylinder from the matrix," which defendants do by cooling the record cylinder so that it shrinks away from the matrix. Claim 4 accurately defines defendant's method, and defendants practice its subject matter. 130

These claims 2, 3 and 4, as well as claim 5, do not set forth in detail the way in which the matrix or mold is formed, but this is done in the remaining claims specified in the question, with more or less minuteness.

Claim 9 is as follows:

> "9. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief, in inserting the continuous cylindrical blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth." 131 132

This claim is like claim 16, except that it is not so specific as to the making of the mold. Claim 16 specifies the depositing of metal vapor in a vacuum and subsequently electroplating thereon. In accordance with claim 9, the process in this respect consists in

133 "depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief." Defendants do this by the specific method which is set forth in detail in claim 16. The remaining recitations of claim 9 are the same as those of claim 16. Accordingly, defendants practice the process of claim 9 of the Edison patent.

Claim 10 is as follows:—

> 134 "10. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal upon the original phonograms so as to form a matrix or mold, in inserting the blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, in finally shrinking the blank to disengage it from the matrix or mold,
> 135 the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth."

Aside from minor differences in phraseology not affecting the steps of the process, claim 10 is like claim 9, except that it specifies additionally "shrinking the blank" to disengage it from the matrix or mold. This
136 is what defendants do. They disengage the impressed blank from the matrix by shrinking it, the shrinkage being due to the cooling. Accordingly, defendants practice the process of claim 10.

Claim 13 is as follows:—

> "13. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal upon the original phonogram to form a matrix or mold, in covering said matrix or mold with

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> a metal backing, in introducing the continuous cylindrical phonogram to be reproduced within said matrix or mold, in expanding said phonogram into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth." 138

This claim is substantially like claim 9, except that it recites an additional step in making the matrix or mold consisting in covering the metal deposited upon the original phonogram "with a metal backing". This is done by defendants. In accordance with the statement of the question, the defendants "re-enforce the film of gold by electroplating a backing of copper or other metal upon it". Accordingly, defendants practise the process of claim 13. 139

Claim 17 is as follows:

> "17. The method of producing record-cylinders for phonographs, which consists in first forming a record on a cylinder of wax or other relatively soft material, rendering the surface of the wax cylinder electrically conductive, and electrolytically depositing metal thereon, forming a matrix, and then outwardly expanding under pressure within the matrix a cylinder or 140 tube of softened material sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder or tube by direct longitudinal movement."

This claim is somewhat different in its recitations from any of the others, so that I will give a separate analysis of it. The claim calls for a method of pro-

141 ducing record cylinders for phonographs, which consists in the following steps:

(1) "Forming a record on a cylinder of wax or other relatively soft material". This refers to the production of the original sound groove. Defendants do this. As stated in the question, the defendants "first take a cylinder of wax or wax-like material bearing upon its peripheral surface a sound record to be duplicated, the same being commonly known as a
142 master record".

(2) "Rendering the surface of the wax cylinder electrically conductive". Defendants do this by depositing a film of gold on the surface of the wax cylinder, thus rendering it electrically conductive.

(3) "Electrolytically depositing metal thereon forming a matrix". Defendants do this by re-enforcing "the film of gold by electroplating a backing of copper or other metal upon it", as stated in the question.

(4) "Then outwardly expanding under pressure
143 within the matrix a cylinder or tube of softened material sufficiently thick to maintain its shape during and after the act of disengagement from the matrix". The question states that defendants' celluloid blank is "of sufficient thickness to maintain its shape under normal conditions and during and after its engagement with the matrix"; and this celluloid cylinder is softened by the steam heat and is expanded under the steam and air pressures within the matrix.

(5) "And finally removing the cylinder or tube by
144 direct longitudinal movement". Defendants do this, as stated in the question.

These are all of the steps of claim 17 and they are all practised by the defendants. Accordingly, defendants use the process of claim 17.

Direct examination closed.

145
Mr. William F. Messer, another witness produced on behalf of complainants, having been duly sworn, deposes and says in answer to questions propounded to him by Mr. Church, of counsel for complainants, as follows :

Q. 1. Give your name, age, residence and occupation ?

A. William F. Messer ; 35 ; 3724 Kelley Avenue, Cleveland, Ohio ; plumber.

Q. 2. Are you acquainted with the members of the 146
firm known as Indestructible Phonographic Record Company ?

A. Yes.

Q. 3. Could you give the names of those persons constituting that firm ?

A. George G. Snowden, James H. Snowden, and Henry McSweeney.

Q. 4. State, if you know, where this firm known as Indestructible Phonographic Record Company is
engaged in business ? 147

A. Albany, N. Y.

Q. 5. How long to your knowledge has this firm been engaged in business at Albany, N. Y. ?

A. April 15, 1907, up to the present time.

Q. 6. State whether or not you were ever employed by that firm, and, if so, when such employment began and ended ?

A. Since February of 1907 up to the 15th of April, 1909.

Q. 7. What was the business of the Indestructible 148
Record Company while you were employed by them ?

A. The manufacture of indestructible phonograph records.

Q. 8. Will you please describe from beginning to end the process or method of producing the so-called indestructible records, practiced by this Indestructible Phonographic Record Company, while you were employed by that company ?

A. In the first place celluloid tube comes about 6 foot long, white material ; it is taken then and put

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into an acetone and nigrocene bath ; it is taken out of that bath and put on a truck and left to dry two days ; from there it goes to a stretching machine ; it is forced over a mandrel by compressed air and trued up ; from there it is cut up into lengths ; from there it goes to what we call a—molding machine ; the ends are turned by heat ; from there it goes to the matrix ; put into the printing machine, as we call it ; it is locked in this machine and 50 pounds of steam pressure is put on it 150 inwardly. The pressure is from within to expand it outwardly. For 50 seconds steam is shut off and 80 pounds of air pressure is applied, until said record is set, and it is taken from the machine and left to cool. It shrinks away from the mold ; then it is taken to a machine and one end is cut off ; then there is a paper backing with metal ends pushed into it in an arbor press ; then the record is taken and tested.

Q. 9. In your last answer you speak of taking the celluloid tubes and putting them into an acetone and 151 nigrocene bath ; will you now tell us why this is done ?

A. The reason that it is put into this bath is to give it the black color and polished smooth surface.

Q. 10. Will you please describe how the matrix or mold was made that is employed in this process ?

> The question is objected to as calling for hearsay unless it is made to appear, which it does not now from the record, that the witness 152 ever participated in or saw the making of matrices.

A. The master record is put in a machine ; in that machine it is gold-plated ; attached to that machine is a vacuum pump ; when this record comes out of there it is all covered with gold and put into a blue vitrol bath and copper plated for twenty-four hours ; the copper is then about one-sixteenth of an inch thick, which is the mold ; it is taken from that bath and the wax master record pushed out ; the ends are turned in

153 a lathe and trued up; after that there is two brass rings sweated on, one on each end.

Q. 11. You say the master record is put in a machine and gold-plated. Describe what you call the master record?

A. The master record is a wax cylinder, when the artist stands in front of the horn and talks or sings, or whatever he may do, into that horn.

Q. 12. What is the effect of the singing, for instance, of the artist, in front of the horn on the cylinder? 154 What, if anything, does it do to it?

A. On the machine is the recorder. As the artist speaks or sings into the horn, this recorder cuts the indentations in the wax record blank, and duplicates whatever he speaks or sings into that horn.

Q. 13. Describe with a little more particularity the machine or apparatus in which the wax master record is placed for the purpose of being gold-plated?

A. All I know is what I saw of the machine in about ten minutes. This record was put into a glass cylinder; 155 in this cylinder were two gold electrodes; the top was put on, vacuum pump started and drew the air out of these glass cylinders, and the master record was gold-plated.

Q. 14. Where was the gold derived from with which the gold-plating was effected?

A. The gold was on two sides; the master record was revolving in this machine.

Q. 15. In what form was the gold?

A. Two rods. 156

Q. 16. Was there any peculiar appearance noticeable while the gold-plating operation was being carried on?

A. From the gold electrode there was a spark between that and the master record.

Q. 17. How long did you see this apparatus in operation?

A. About ten minutes.

Q. 18. Where was this apparatus that you saw in operation?

A. 352 Livingston Street, Brooklyn, N. Y.

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Q. 19. At whose establishment was it ?

A. The Indestructible Phonographic Record Company's Laboratory.

Q. 20. Are we to understand that the Indestructible Phonographic Record Company had an establishment or laboratory in Brooklyn, and another establishment at Albany, N. Y. ?

A. Yes, sir.

Q. 21. State whether or not the molds or matrices 158 that were used at Albany, as you have testified, were like or different from the molds or matrices that you saw made at Brooklyn ?

A. The molds which I saw made at the Brooklyn laboratory were the same as were used in the Albany factory.

Q. 22. When the wax master record was removed from the gold lined matrix or mold, what appeared on the gold lined matrix ?

A. In the first place the master record had the gold 159 on it ; after the matrix was completed, the master record pushed out, the gold stayed in the matrix.

Q. 23. But, I am now asking you as to the appearance of the inside of the gold-lined matrix after the master had been removed from it ?

A. On the inside of the mold were the indentations or copy of the master record.

Q. 24. Now when the celluloid blank was placed within the gold lined matrix or mold of the printing machine and steam at a pressure of 50 pounds was 160 admitted within that celluloid blank, what was the effect upon the celluloid blank of the steam ?

A. When the celluloid blank is put into the mold and set into the printing machine and locked, steam is turned on ; steam softens the material and forces it against the inner walls of the matrix.

Q. 25. What was the effect then of turning off the steam and admitting within the celluloid blank the air pressure at 80 pounds ?

A. The air pressure made the indentations more fully.

161

Q. 26. Do you mean that the effect of the air pressure was to make the contact between the celluloid and the matrix closer and more intimate ?

A. Yes.

Q· 27. Will you please examine the sketch which I now show, and state if you know, who made it and when it was made, and what it represents ?

A. This sketch I made, represents a matrix, top and bottom plate of a printing machine, and was made on the 3d of July, 1909. 162

> The sketch referred to by the witness is offered in evidence by counsel for the complainants, and marked "Complainants' Exhibit, Drawing of Defendants' Apparatus."

Q. 28. Will you please take this sketch and state to the Examiner what each one of the numbered parts represents ?

A. 1 represents the matrix, 2 top rings sweated on 163 the matrix, 3 bottom ring sweated on matrix, 4 celluloid blank inside of matrix, 5 bottom plate where matrix sets on, 6 top plate, which closes the upper end of the matrix, 7 is a flange on plate 6, 8 is turned end on celluloid, 9 is a brass plate with three screws screwed on bottom plate, 10 is the top plate, 11 is the steam pipe, 12 is a vent through the top plate, 13 is a vent to release the air between the record and the matrix, 13 leads into 14, and 15 represents the bottom vents. 164

Q. 29. State, if you know, who invented this apparatus that is pictured in the sketch ?

A. I, William F. Messer, invented the device shown in the sketch.

Q. 30. Mr. Messer, did you ever obtain a patent for any portion of the apparatus shown in this sketch ?

A. Not that, but the idea is the same as the old Messer patent.

Q. 31. By the old Messer patent, state whether or

165 not you refer to the patent granted to W. F. Messer, July 29, 1902, No. 705,772?

A. That's right.

Q. 32. Do you or not regard the apparatus shown in the sketch to which we have referred as a modification of the device shown in the patent referred to?

A. Yes, I do.

Q. 33. To what extent was the process which you have described as having been used by Indestructible
166 Phonographic Record Company practiced during your connection with that Company?

A. This process was used every day during the time I was there, which was two years, at Albany. There were in the neighborhood of 5,000 records made every day.

Q. 34. State please which members of the firm constituting Indestructible Record Company were present while this process which you have described was being practised at Albany?

167 A. George G. Snowden, James H. Snowden and Henry McSweeney.

Q. 35. State whether or not either of these men actually participated in the work of manufacturing records or simply directed such manufacture?

A. They only directed affairs.

Q. 36. Who had charge of the work of manufacturing records with the process you have described at the factory of Indestructible Record Company at Albany while you were there?

168 A. Mr. B. F. Philpot for General Manager, Fred Matthews, Manager of Laboratory, Brooklyn, and W. F. Messer, Superintendent of the factory at Albany.

Q. 37. State whether or not all of the molds or matrices that were used at Albany by Indestructible Phonographic Record Company were made at Brooklyn, at the laboratory.

A. Yes, they were all made at Brooklyn, for use at the Albany factory.

Q. 38. Will you please examine the article that I

169 now show you and state, if you please, what it is, who made it, and when it was made?

A. This article which I have in my hand is a celluloid blank, such as was used in the process of the manufacture of indestructible phonograph records. This blank was made by me in February, 1909, at the Albany factory of Indestructible Phonographic Record Company.

> The sample blank referred to by the witness is offered in evidence and marked "Complainants' Exhibit, Celluloid Blank of Defendants' Manufacture." 170

Q. 39. Please examine the record that I now show you and state, if you know, what it represents, and whether you have ever seen anything like it before?

A. This record which I have in my hand is a phonograph record mutilated by the cutting of parts from it. I have seen unbroken records like this before. 171

Q. 40. State how the record that is in your hand compares as to structure with those that were made by Indestructible Phonographic Record Company while you were connected with that Company as you have testified?

A. The record which I have in my hand is the same as the Indestructible Phonographic Record Company of Albany, New York, have been manufacturing while I was in their employ.

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> Counsel for complainants offers in evidence the record referred to by the witness and the same is marked "Complainants' Exhibit, Sample of Record of Defendants' Manufacture."

CROSS-EXAMINATION BY MR. SCOTT:

x-Q. 41. When question 6 was asked, you made some remark about going to work in 1900; will you please state for whom you went to work at that time?

173 A. I went to work for the Lambert Company at Chicago.

x-Q. 42. How long did you work for the Lambert Company in Chicago?

A. Two years.

x-Q. 43. In what business was the Lambert Company engaged?

A. The manufacture of indestructible records.

x-Q. 44. Of what material was these records made?

174 A. Celluloid.

x-Q. 45. Was the celluloid in the form of a cylinder similar to the records you have been testifying about?

A. Yes.

x-Q. 46. How was the phonographic record produced upon the celluloid cylinder?

A. The celluloid record was made in copper molds under steam and air pressure.

x-Q. 47. Was the process carried on by the Lambert Company in a general way similar to that which 175 you have described as being carried on by the Indestructible Phonographic Record Company?

A. The matrix was not made the same at that time. The master record at that time was coated with graphite, put into a blue vitriol bath twelve hours.

x-Q. 48. The matrix produced by the process used by the Lambert Company was a hollow cylinder, was it not, with the phonographic record on the inside thereof?

A. Yes.

176 x-Q. 49. Was the process of printing the celluloid blanks, that is, the process of forming the record on the celluloid blank from the matrix, performed by the Lambert Company in a manner similar to the process you have described as performed by the Indestructible Phonograph Company?

A. Yes.

x-Q. 50. As I understand you then, the Lambert Company placed a hollow celluloid blank inside of a matrix, sealed the ends, then allowed steam to flow to the inside of the blanks to expand the same against

177 the matrix, then turned off the steam and turned on air under pressure, then turned off the air, permitted the blank and matrix to cool and then withdrew the blank, is that correct?

A. Yes.

x-Q. 51. Was the Lambert Company located in Chicago, and if so, upon what street, when you worked for it?

A. They were located at 110–112 South Jefferson Street, Chicago. 178

x-Q. 52. After stopping your work for the Lambert Company at 110–112 South Jefferson Street, what did you next do?

A. I went for the Lambert Company in July, 1902 to London, England, and erected a plant there.

x-Q. 53. How long did you stay in England?

A. I went from there and landed in New York day before Christmas, 1904.

x-Q. 54. When did you next engage in phonograph record manufacturing? 179

A. February, 1907.

x-Q. 55. For whom did you work at that time?

A. For the Indestructible Phonographic Record Company.

x-Q. 56. Where was this Company located when you went to work for them in February 1907?

A. 110–112 South Jefferson Street, Chicago.

x-Q. 57. This is the shop in which you had previously worked for the Lambert Company, is it not?

A. Yes sir. 180

x-Q. 58. In the shop of the Indestructible Phonographic Record Company, when you commenced work for that company, in February 1907, did you see any of the machinery that had previously been in the shop of the Lambert Company at that place?

A. Yes.

x-Q. 59. Was much of the old machinery of the Lambert Company in the shop of the Indestructible Record Company?

A. 18 printing machines.

181

x-Q. 60. Where was the rest of the machinery, if you know, that the Lambert Company had used?

A. I don't know.

x-Q. 61. How many printing machines had the Lambert Company had?

A. 50, but they were not all erected.

x-Q. 62. Please tell us how many of the 50 machines which the Lambert Company had, there were erected?

A. 24.

182 x-Q. 63. Were any of the same people in charge of the Indestructible Phonographic Record Company that had previously been in charge of the Lambert Company?

A. Yes, there was B. F. Philpot, F. W. Matthews, and W. F. Messer.

x-Q. 64. When you were connected with the Lambert Company, did you know anything about who their customers were?

183 This and all further questions relating to the Lambert Company and its business is objected to by counsel for complainants, as foreign to the subject of the direct examination of the witness, and as therefore not proper cross-examination, this objection to apply by consent of counsel for defendants, to all further questions in the same line without repetition.

A. No.

184 x-Q. 65. When you entered the employ of the Indestructible Phonographic Record Company in February, 1907, were they carrying on the manufacture of phonograph records, according to the same method as that previously practised by the Lambert Company?

A. Yes.

x-Q. 66. How long did you work for the Indestructible Phonographic Record Company, at 110–112 So. Jefferson Street, Chicago?

A. Six weeks.

185

x-Q. 67. What did you do then ?

A. I dismantled the place and shipped the machinery to Albany.

x-Q. 68. Did you go to Albany, and if so, what did you do there ?

A. I went from Chicago to Brooklyn and equipped the laboratory, and from Brooklyn I went to Albany, N. Y. and equipped the factory for the manufacture of indestructible records.

x-Q. 69. How long were you in Brooklyn ? 186

A. About six weeks.

x-Q. 70. When you went to Albany from Brooklyn, did you set up the machinery which had previously been in the plant of the Indestructible Phonographic Record Company at 110-112 South Jefferson Street, Chicago ?

A. No, but used parts of it for molding machines.

x-Q. 71. By " molding machines," what kind of machines do you mean, that is, machines for what use ?

A. Arbor presses for turning the ends of the celluloid blanks. 187

x-Q. 72. By this I infer that you refer to the machine which form the flanges at the end of the celluloid blanks ; is that correct ?

A. Yes.

x-Q. 73. Were any of the printing machines, or parts of printing machines shipped from Chicago, set up in the Albany factory ?

A. No.

x-Q. 74. Were any of the matrices that had been used in Chicago used in Albany ? 188

A. Yes, language matrices.

x-Q. 75. Do you know for whom these language matrices were used, that is, to whom the language records were supplied ?

A. They were supplied to the International Phonographic Language School.

x-Q. 76. When did you first hear of the International Phonographic Language School ?

A. 1907—February.

189 x-Q. 77. What did you do while you were in England for the Lambert Company?

A. I erected a plant and took charge and superintended it.

x-Q. 78. Were your operations there successful, or did you have trouble with the manufacture of records?

A. I had more or less trouble with the celluloid that we got from the British Xylonite Company. Afterwards we got German material, which worked all right.

190 x-Q. 79. What was the trouble with the celluloid furnished by the Xylonite Company?

A. It was too brittle.

x-Q. 80. How did it act when you attempted to print from it, that is, when you inserted it in a matrix and attempted to form a record by injecting steam and then air?

A. It cracked rather than stretched when steam was applied.

x-Q. 81. I understand you to mean that it would 191 crack so that there would be a hole right through the blank? Is that correct?

A. Yes.

x-Q. 82. Did you observe one of these cracked records after you took it out of the matrix, to see whether the record was printed on the blank near the crack?

A. It would not print at all.

x-Q. 83. Do you mean that there would be no impression on any part of the blank in case it cracked?

192 A. No, there would not be any record.

x-Q. 84. The fact that the record did not print was because the record was not forced against the matrix by the steam or air pressure, was it not?

A. Yes.

x-Q. 85. In other words, the steam and air escaped to the outside of the record, thereby giving rise to the same pressure on both sides, and preventing the record blank from being forced outwardly against the matrix, is that correct?

A. Yes.

193

x-Q. 86. Under these circumstances then, as I understand you, the heating of the record by the steam, the blank being cracked, did not expand the record blank outwardly so as to print the phonographic record thereon, is that correct?

A. Yes.

x-Q. 87. As I understand you then, a blank could not be printed by simply inserting it into a matrix and heating it, but that pressure was necessay in addition. My question refers to a celluloid record, of course; am I correct? 194

A. Yes.

x-Q. 88. When steam was turned into one of these record blanks and the blank cracked, thus forming a hole through the blank, what was the shape of the blank when you took it out of the matrix?

A. Well, it would shrink back to its original shape.

x-Q. 89. The heat then did not expand it, but on the contrary caused it to shrink and curl up, is that right? 195

A. Yes.

x-Q. 90. You stated in your answer to Cross question 88, that the blank would shrink back to its original shape. By original shape, what shape do you refer to?

A. When the material is received in the rough it is more or less flat.

x-Q. 91. By this I understand you to mean that when the celluloid tubes were delivered to you, they were not truly circular, but flattened and distorted; is this correct? 196

A. Yes.

x-Q. 91. In truing up these tubes for the purpose of making them perfectly round, were they stretched?

A. Yes.

x-Q. 92. And in the process as practiced by the Indestructible Phonographic Record Company, as you have described, were they also stretched in this way?

A. Yes.

x-Q. 93. What are the end flanges for upon the

197 ends of the celluloid blanks; that is the turned in ends?

A. To form the seal.

x-Q. 94. In carrying out the process you have described, as conducted by the Indestructible Phonographic Record Company, did it ever happen that the flanges failed to properly seal the blank?

A. Yes, but very seldom.

x-Q. 95. When such failure occurred, I understand
198 from your testimony that the steam would not be confined to the inside of the blank, but would escape to the outside thereof, that is, between the blank and the matrix? Is that correct?

A. Yes, that is right.

x-Q. 96. When this happened, what was the shape of the blank when you took it out of the cylinder or matrix?

A. The inturned ends would be fluted and the rest of it would be its original shape before it was stretched.

199 x-Q. 97. I understand then that under these circumstances the blank would come out of the matrix smaller than it was when it was put in?

A. Yes.

x-Q. 98. And I also understand that under these circumstances the blank would come out without any phonographic record on the outside thereof?

A. Yes.

x-Q. 99. Were the records manufactured while you were with the Indestructible Phonographic Record
200 Company after they had become established at Albany serviceable and satisfactory in use?

A. Yes.

x-Q. 100. Do you have any idea as to how many times one of these records manufactured by the Indestructible Phonographic Company at Albany could be played, that is reproduced in a phonograph, without wearing out to such an extent as to impair its value?

A. I never gave it a test.

x-Q. 101. In your operations at Albany for the In-

201 destructible Phonographic Record Company, did you ever observe what happened when the celluloid tube was dipped in a solution of nigrocene and acetone, and then dried in an oven?

A. The first record blanks made by the Lambert Company were dried in an oven.

x-Q. 102. What effect would this have upon the blanks?

A. Have no effect at all.

x-Q. 103. What was the occasion of your being in Brooklyn as you have testified, at the laboratory of the Indestructible Phonographic Record Company, that is, how did you happen to be there? I mean, at the time you have said you saw the gold-moulding process. 202

A. I took a trip down to see the laboratory and the improvements which had been made while I was at the Albany factory.

x-Q. 104. Who did you go to the Brooklyn laboratory with? 203

A. I went there alone.

x-Q. 105. Who did you meet when you went there?

A. Mr. Matthews, George G. Snowden, and of course, who ever was working there.

x-Q. 106. Do you remember the names of any of the other parties working there?

A. Hayden Gaines, Mr. Wadcock, Mr. Matthews' father-in-law.

x-Q. 107. Did any or all of these gentlemen show you around the laboratory? 204

A. No, just Mr. Matthews.

x-Q. 108. How did the outside of the master record look after it was gold-moulded, as you have stated? That is, what color was it and what other peculiarities did it have?

A. It was gold-plated.

x-Q. 109. What was the color of the gold?

A. Yellow.

x-Q. 110. Did you ever see any of the artists per-

205 forming before the horn of one of the phonographs for the purpose of making a master record?

A. No.

x-Q. 111. When you were in the laboratory did you see a master record placed in the gold-moulding machine, or was one already in there when you entered?

A. One was in there.

x-Q. 112. Did you see that record which was in the
206 gold-moulding machine, that is, the same one, taken out and electroplated?

A. No.

x-Q. 113. Did you see the electroplating operation at all?

A. Yes.

x-Q. 114. State just what you saw?

A. A row of glass jars in which was blue vitrol, a copper anode hung on the inside, charged with electricity wax record set down in the centre with a wire
207 on each end charged with electricity.

x-Q. 115. What were the jars made of?

A. Glass.

x-Q. 116. How large were they?

A. About 8 by 12.

x-Q. 117. Were these jars in the same room with the gold-moulding machines?

A. No.

x-Q. 118. You stated that there was a spark between the gold electrode and the master record. Can
208 you describe a little more fully the appearance of this spark? That is, was it a small bright spark, or did it have some other appearance?

A. It was a blue or greenish spark.

x-Q. 119. Did this spark light up the entire glass cylinder?

A. No.

x-Q. 120. You have stated that in the printing process as carried on by the Indestructible Phonographic Record Company at Albany, the steam softens the material, that is the celluloid. From your experience,

209

can you say what it is about the steam that softens the celluloid, that is, whether it is the heat of the steam, or what it is ?

A. It is the heat.

x-Q. 121. You also stated that the steam forces the celluloid against the inner walls of the matrix. Does your experience enable you to state whether it is the heat of the steam, or its pressure, that causes it to force the celluloid against the inner walls of the matrix ? 210

A. Pressure.

x-Q. 122. When was it that you resigned your position with the Indestructible Phonographic Record Company ?

A. About the first of April, 1909.

x-Q. 123. Who was the active manager of the Lambert Company while you were employed with that company ?

A. Mr. B. F. Philpot.

x-Q. 124. And who was the active manager of the 211
Indestructible Phonographic Record Company when
you were employed by it ?

A. Mr. B. F. Philpot.

x-Q. 125. How is it that you know, as you have stated, that all of the molds or matrices used at Albany by the Indestructible Phonographic Record Company were made at the Laboratory in Brooklyn ?

A. I received all the shipments which come from there.

x-Q. 126. Do you mean that you personally opened 212
the boxes ?

A. I do, and inspected them as they came in.

x-Q. 127. Were any matrices used by the Indestructible Phonographic Record Company at Albany, which had been made by the International Phonographic Language School ?

A. Yes.

x-Q. 128. Have you any knowledge as to when the Indestructible Phonographic Record Company first began to practise at its Brooklyn Laboratory, the

213 process which you have described as being conducted there?

A. Sometime in 1908.

x-Q. 129. How are you enabled to remember this date?

A. I am a very poor one to keep dates.

x-Q. 130. From your experience in manufacturing phonograph records, did you consider it possible to form a celluloid record by pressing it against the matrix without first softening the celluloid? 214

A. No.

RE-DIRECT BY MR. CHURCH:

Re-d. Q. 131. State whether or not the effect of steam under pressure upon the celluloid blank is not first to soften it and then to press outward against the matrix? In other words, are not both heat and pressure necessary?

215 A. Yes, they are necessary.

Re-d. Q. 132. Were or were not the wax records that you say you saw suspended in the jars in Brooklyn gold covered records?

A. Yes.

Re-d. Q. 133. You have spoken of certain apparatus having been sent from Chicago to Albany. Will you please state what became of that apparatus?

A. The old printing machines from the Chicago plant was sent to Albany, parts of them have been used for molding machines. 216

Re-d. Q. 134. When was it, as nearly as you can recollect, when you saw the gold-moulding process working in Brooklyn?

A. February, 1908.

Re-d. 135. When were the gold moulded matrices or molds first received at Albany, to your knowledge?

A. It was shortly after I had been at Brooklyn and saw the process in operation.

217

By Mr. Scott:

Re-x-Q. 136. You have stated that the master records which you saw in the electroplating jars in Brooklyn, were gold-moulded records. What was the condition of these records at the time you saw them, that is, how long had they been in the jars, if you know?

A. About six hours.

Deposition closed.

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William F. Messer.

Adjourned to Thursday, January 13, 1910, at 10 A. M.

January 13, 1910.

Met pursuant to adjournment.

Parties present as before. 219

The testimony of the witness, **Arthur S. Browne**, is continued.

Cross-examination by Mr. Scott:

x-Q. 6. I notice that some of the claims regarding which you have testified refer to softening the blank by heat and that others do not. Will you state whether you find anything in the specification of the 220
patent, that is the descriptive part, referring to heat as a softening agent?

A. I do not in so many words. It refers, however, to the employment of heat and specifies materials which are softened by heat.

x-Q. 7. Do you know of any material available for use in making phonographic records that would not be softened by heat?

A. Yes.

221

x-Q. 8. Did you ever see any commercial marketable records made of such materials?

A. Yes.

x-Q. 9. What were these materials?

A. Paper.

x-Q. 10. Other than the mention of materials which are softened by heat, do you find anything in the specification of the patent which to your mind indicates that softening was contemplated?

222 A. Yes, the specification describes a molding or
impressing process, whereby a blank is brought forcibly
into contact with a surface from which the impression
is to be taken. This taken in connection with the
recitation of materials which are softened by heat and
the statement that heat is employed, makes the inference
inevitable that softening is contemplated where
the nature of the materials is such that softening is
necessary to render them plastic. For example, the
patent refers to sealing wax (line 14, page 3). Every
223 one is familiar with the fact that sealing wax will not
take an impression in its normal condition, but that
when softened by heat an impression is readily taken.
No one, therefore, could fail to understand that when
the patent mentions such a material and describes
heating as a step in the process and the taking
of an impression by pressing the wax against
the mold, that one purpose of the heating
is to bring the wax into a sufficiently
soft condition to render it plastic enough to take an
224 impression.

x-Q. 11. When wax is used, this being one of the materials mentioned in the patent, what function would be served by heat, that of softening the wax, or that of expanding it merely, or both?

A. The function of softening the wax would always exist. If the wax were of such a character that it would be expanded by heat, then the function of the heat would be to expand it. It would not be possible to expand the wax without softening it in case heat were employed.

225

x-Q. 12. From your knowledge of the phonographic art can you state whether the degree of heat used in manufacturing wax records would have enough softening effect to be of any material utility?

A. I can. The softening is of great utility.

x-Q. 13. Why is it that in the process described in the patent in suit the records are, as stated in some of the claims regarding which you have testified, removed by direct longitudinal movement?

A. Because the duplicated records are so shrunk by 226
chilling that they are free from contact with the bore of the mold and consequently can be removed by pulling them straight out.

x-Q. 14. About how much do the records have to shrink from the mold to render it possible to remove them from the cylindrical matrix without injury?

A. They have to shrink far enough to enable the irregular sound groove in the duplicate record to get entirely free from the projecting sound rib of the mold and with sufficient additional clearance so that re- 227
moval can be effected without any danger of accidental scraping which might hurt either the record or the mold. I can not state in fractions of an inch just what this shrinkage should be.

x-Q. 15. In making flat phonographic records, commonly called disc records, that is, records in which the phonographic indentations are formed in a spiral path on a flat surface, would any difficulty arise in separating the record from the disc, such as would necessitate shrinking the record in order to remove it from the 228
matrix without injury to either?

A. I do not know. I am not familiar with the manufacture of flat disc records.

x-Q. 16. In the patented process, in which the record is warmed upon the inside of an integral cylindrical matrix, it is absolutely necessary, is it not, to disengage the projections on the record from the indentations in the matrix before the record can be removed?

A. Yes.

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x-Q. 17. There would seem to be no reason, would there, in the manufacture of a flat disc record from a flat disc matrix, why the record after being formed, could not be lifted away from the matrix by a movement at right angles thereto, as distinguished from drawing the record out, as is done in the manufacture of cylindrical records, by a movement which causes the surface of the record to move parallel with the surface of the matrix, and furthermore it would seem, would it
230 not, in the manufacture of disc records as described, any preliminary shrinking of the record, prior to moving it bodily away from the matrix, would be unnecessary?

A. I do not know. I do not know how disc records are made and consequently can express no opinion.

x-Q. 18. In lines 32 to 35, page 1, of the specification of the patent in suit, it is stated that the patentee's process is applicable to the manufacture of flat discs. Can you state whether the process de-
231 scribed in this patent is of any utility in connection with the manufacture of disc records, and if so, of what utility?

A. I cannot state.

x-Q. 19. Is the step of removing the record from the cylindrical matrices described in the patent by direct longitudinal movement an essental part of the process, or merely incidental to the fact that the matrix is made in the form of a hollow cylinder with the phonographic record formed upon its smooth interior surface, and the
232 further fact that the reproduced record is formed upon a cylindrical blank initially having a smooth cylindrical surface.

A. It is essential to the process as set forth in the claims which I have considered. I notice there are other claims in the patent which I did not consider in my direct examination, such as claims 1, 7, 8 and 18, in which nothing is said about the record being cylindrical, nothing is said about removal by direct longitudinal movement; and, therefore, so far as the process recited in those claims is concerned, I do not

233 regard the removal by direct longitudinal movement as essential.

x-Q. 20. Are not all of the claims directed to the same process?

A. In one sense yes, and in another no. In accordance with some claims certain specific steps are necessary, which may be omitted in the practice of the process of other claims. Accordingly, in this sense, they are not directed to the same process. 234 On the other hand, all of the claims recite steps which may all be employed or may be in part employed in a single specific process and in that sense they are all directed to the same process. Different claims, however, are applicable to different processes which may be in many respects unlike.

x-Q. 21. Could these processes be unlike in the manner of removing the record from the matrix? That is, is there any other way of removing the record from the matrix other than by a direct longitudinal movement 235 as specified in some of the claims regarding which you have testified?

A. So far as the language of some of the claims are concerned, they would apply to a process wherein the duplicate record might be removed otherwise than by direct longitudinal movement, assuming of course the existence of such a mode of removal. Take, for example, claim 18. The language of this claim contains nothing to indicate the shape of the celluloid tablet, nor as to how it may be removed. 236 The language of claim 18 might apply to a flat record and the removal from the matrix might be made by destroying the matrix, so far as anything stated in the claim is concerned.

x-Q. 22. In the case of a hollow cylindrical matrix, and a cylindrical record formed therein, as described in the patent and referred to in several of the claims, for instance claim 4, would there be any other possible way of removing the record after it is formed than by a direct longitudinal movement?

A. Yes, the matrix might be destroyed.

237 x-Q. 23. Without destroying either the matrix or record, would removal of the record other than by a direct longitudinal movement be possible under the conditions set forth in cross-question 22 ?

A. Not practically.

x-Q. 24. What do you understand by direct longitudinal movement ?

A. Separating the mold and record by moving one or both parallel with the longitudinal axis of the mold so
238 that there is no injurious scraping contact between the two during separation.

x-Q. 25. I understand then that the essential thing about the removal of the record is that the interlocking projections and indentations on the matrix and record respectively should be disengaged, and then that the removal of the record should be accomplished by such a movement as will not result in causing the surfaces of the record and matrix to contact in such manner as to injure either ?

239 A. Yes.

x-Q. 26. The essential condition then of this movement of separation between the matrix and record resides in separating the surfaces of these two objects and taking one from the other in such a way that the spaced apart surfaces thereof will move approximately parallel one to the other.

A. Yes.

x-Q. 27. Then, as I understand it, the phrase "direct longitudinal movement", occurring in the claims
240 you have testified about, contain no particular significance other than as referring to the fact that after the indentations and the projections on the record and the matrix respectively have been disengaged one from the other, the record is removed from the matrix by such a movement as will cause the surface of the record bearing the phonographic indentations to travel in a path parallel to the inner surface of the matrix which bears the projections constituting the phonographic impression ?

A. Yes.

241 x-Q. 28. If the record were revolved upon its longitudinal axis, its outer cylindrical surface would travel in a path parallel to the inner cylindrical surface of the matrix, would it not?

A. No.

x-Q. 29. Why not?

A. The movement would then be a concentric one and not a parallel one.

x-Q. 30. Do you not consider two arcs struck from the same centre as parallel? 242

A. No.

x-Q. 31. Is it your idea that parallelism can exist only between straight lines or plane surfaces?

A. Strictly speaking, yes.

x-Q. 32. Under the conditions assumed in cross-question 28, would not the surface of the record at all times be at the same distance from the inner surface of the matrix, assuming that the axis of the record and matrix were coincident?

A. No. 243

x-Q. 33. Would the movement described in cross-question 28, any more than a direct longitudinal movement, cause the surface of the record to contact with and possibly injure the matrix or the surface of the record itself?

A. It would not.

x-Q. 34. Then I assume that for the successful carrying out of the patentee's process it is not necessary to remove the record from the matrix by a direct longitudinal movement to the exclusion of a rotary or 244
twisting movement. Is this this correct?

A. The present question seems to assume that the movement described in cross-question 28 would effect a removal, whereas it would not. The successful carrying out of the process of the patent, so far as the claims discussed on my direct examination, is concerned, requires such a complete disengagement of the record and matrix that there shall be a clearance between them so that if the record is then pulled straight out, there shall be no scraping of the surfaces one upon

245 the other (at least to any extent which might possibly mar them) and the removal is effected by pulling them apart along a path substantially parallel with the axis of the matrix. If the clearance should be effected, it would not be absolutely necessary to have exact mathematical accuracy in pulling the record out. Accordingly, with a proper clearance, if the record should be twisted a little in pulling it out, there would be no substantial departure from the direct longitudinal
246 movement called for by the claims.

x-Q. 35. As I understand you then under the conditions assumed in your last answer a twisting movement of the record, that is a rotation thereof on its longitudinal axis, such rotation being simultaneous with the direct longitudinal movement of withdrawal, would not cause any injury to the record or matrix, provided of course that its removal is done with the ordinary care used in such operation?

A. Yes, provided the disengagement between the
247 matrix and record is sufficient so that the clearance is sufficiently great to enable the record to be pulled straight out, then the assumed and unnecessary concurrent rotation would not involve any injury.

Deposition closed.

ARTHUR S. BROWNE.

248 Counsel for complainant offers in evidence a certified copy of letters patent of the United States to Thomas A. Edison, numbered 713,209, and dated November 11, 1902, for Improvement in Processes for Duplicating Phonograms, and the same is marked "Complainants' Exhibit, Complainants' Patent in Suit."

Also, assignment of said letters patent No. 713,209 from Thomas A. Edison to National Phonograph Company, dated December 16, 1902, acknowledged December 16, 1902, recorded December 18, 1902 in Liber D-66, page 473 of Transfer of Patents.

249 Also, assignment of said letters patent No. 713,209 from National Phonograph Company to New Jersey Patent Company dated March 28, 1906, acknowledged March 28, 1906, and recorded in Liber V-74, page 200, of Transfer of Patents.

It is agreed by counsel for defendants that said instruments of assignment may be copied into the record and said copies used with the same force and effect as the originals thereof, 250 said originals or proven copies thereof to be, however, produced at the hearing if called for by counsel for defendants.

It is further stipulated and agreed by and between counsel for the respective parties hereto, that Frank L. Dyer, a resident of Montclair, New Jersey, if called as a witness for the complainants, would testify that he is the Vice-President of the New Jersey Patent Company, one of the complainants herein 251 and the owner of the legal title to patent No. 713,209 in suit, and that the National Phonograph Company, the other complainant herein now is and at all times since the 12th day of November, 1902, has been the exclusive licensee to manufacture, use and sell cylindrical phonograph records made in accordance with the invention described by said patent.

252 Counsel for complainants also offers in evidence a copy of patent No. 705,772, granted to Wm. F. Messer, July 29, 1902, for Apparatus for Reproducing Phonograms, referred to in the deposition of Wm. F. Messer, and the same is marked "Complainants' Exhibit, Messer Patent No. 705,772."

253

(Copy of Assignment from Thomas A. Edison to National Phonograph Company.)

WHEREAS, I Thomas A. Edison, of Llewellyn Park, in the County of Essex and State of New Jersey, did obtain Letters Patent of the United States No. 713,209, on the 11th day of November, 1902, for a process of duplicating phonograms:

AND WHEREAS, I am the sole and exclusive owner of
254 said Letters Patent and the invention described therein, and of all rights and privileges thereunder;

AND WHEREAS, National Phonograph Company, a corporation organized and existing under and by virtue of the laws of the State of New Jersey and having its principal place of business at Orange, in the County of Essex in said State, is desirous of acquiring said Letters Patent and all rights thereunder;

Now, therefore, to all whom it may concern, be it known that for and in consideration of the sum of one
255 dollar, lawful money of the United States, to me in hand paid, the receipt of which is hereby acknowledged, I, the said Thomas A. Edison, have sold, assigned and transferred, and by these presents do sell, assign and transfer to the said National Phonograph Company, its successors or assigns, my entire right, title and interest in and to the aforesaid Letters Patent No, 713,209 dated November 11, 1902, and the invention described and claimed therein, together with any and all right or rights of action, claims and demands
256 whatsoever, either at law or in equity, for damages or profits, or both, for which I have or may have, for past infringement of said Letters Patent, with full right to the said National Phonograph Company, in its own name, to sue upon and collect the same for its own use and behoof; the same to be held and enjoyed by the said National Phonograph Company, its successors or assigns, to the full end of the term for which said Letters Patent are or may be granted, as fully and entirely as the same would have been held and enjoyed by me had this assignment and sale not been made.

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In witness whereof, I have hereunto set my hand and seal this 16th day of December, 1902.

THOS. A. EDISON.

In the presence of
FREDERICK C. DEVONALD,
J. A. BOEHM.

STATE OF NEW JERSEY, } ss. :
County of Essex, }

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Be it remembered that on this 16th day of December, 1902, before me, JOHN F. RANDOLPH, a Notary Public, personally appeared Thomas A. Edison, who I am satisfied is the person named in and who executed the within assignment, and I having first made known to him the contents thereof, he acknowledged that he signed, sealed and delivered the same as his voluntary act and deed for the uses and purposes therein specified.

JOHN F. RANDOLPH,
Notary Public for New Jersey. 259

(SEAL)
John F. Randolph,
Notary Public,
New Jersey.

(Copy of Assignment from National Phonograph Company to New Jersey Patent Company.)

" WHEREAS, letters Patent of the United States were granted to Thomas A. Edison, No. 667,662, dated February 5th, 1901, for " Process of Duplicating Phonograph Records ; " and whereas Letters Patent of the United States were granted to said Edison No. 713,209, dated November 11, 1902, for " Process of Duplicating Phonograms ; " and whereas, the entire right, title and interest in and to each of said Letters Patent were assigned by said Edison to the National Phonograph Company, a corporation organized and existing under the laws of the State of New Jersey, the assignment of the first mentioned patent being 260

261 dated December 4th, 1901, and being recorded December 7th, 1901, in Liber U-63, page 465 of the records of the United States Patent Office, and the assignment of the second of said patents being dated December 16th, 1902, and being recorded December 18th, 1902, in Liber D-66, page 473 of the records of the United States Patent Office; and

WHEREAS, the New Jersey Patent Company, a corporation duly organized and existing under the laws 262 of the State of New Jersey, is the equitable owner of the entire right, title and interest in and to each of said patents, and has been such equitable owner thereof since the 27th day of June, 1903, and now desires to acquire the legal title in and to each of said patents:

Now, therefore, to all whom it may concern, be it known that for and in consideration of the sum of one dollar, lawful money of the United States, paid by the New Jersey Patent Company to the National Phonograph Company, receipt of which is hereby acknowl- 263 edged, the said National Phonograph Company has sold, assigned and transferred, and by these presents does hereby sell, assign and transfer unto the said New Jersey Patent Company its successors and assigns, the entire right, title and interest in and to each and both of said Letters Patent and the inventions described and claimed therein, together with any and all right or rights of action, claims, or demands whatsoever either at law or in equity for damages or profits or both which the said National Phonograph Company has or 264 may have for past infringement of either or both of said Letters Patent, with the full right to the said New Jersey Patent Company in its own name to sue for and collect the same for its own use and behoof; the same to be held and enjoyed by the said New Jersey Patent Company, its successors or assigns to the full end of the respective terms for which the said letters patent are or may be granted as fully and entirely as the same would have been held and enjoyed by the said National Phonograph Company had this assignment and sale not been made.

Raymond R. Wile Research Library

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In witness whereof the said National Phonograph Company has hereto affixed its corporate seal and caused these presents to be signed by its president this 28th day of March, 1906.

NATIONAL PHONOGRAPH COMPANY,
By WILLIAM E. GILMORE,
President.

Attest:
(SEAL) A. WESTEE,
Secretary. 266

STATE OF NEW JERSEY } ss.:
County of Essex. }

On this 28th day of March, 1906, before me personally appeared Alphons Westee, the secretary of the National Phonograph Company, with whom I am personally acquainted, who being by me duly sworn, deposed and said that he resided in West Orange, New Jersey, and was the secretary of the National 267 Phonograph Company, the corporation described in and which executed the foregoing instrument; that he knew the corporate seal of the said company; that the seal affixed to the said instrument was said corporate seal and was so affixed by order of the Board of Directors of the said company; and that he attested the same by subscribing his name to the said instrument as secretary of the said company by like order.

ALPHONS WESTEE. 268

Sworn and Subscribed to before me this 28th day of March, 1906. }

FRANK L. DYER,
(SEAL) Notary Public,
State of New Jersey.
Commission Expires February, 1908.

COMPLAINANT'S PRIMA FACIE CASE CLOSED.

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STATE OF NEW JERSEY, } ss.:
County of Essex. }

I, ANNA R. KLEHM, a Notary Public in and for said county and State, duly commissioned and qualified, and authorized to administer oaths, and to take and certify depositions, do hereby certify that, pursuant to the annexed notice issued and served in the civil cause depending in the Circuit Court of the United States
270 for the Northern District of New York, wherein New Jersey Patent Company and National Phonograph Company are complainants, and George G. Snowden, James H. Snowden and Henry McSweeney, doing business as a co-partnership under the name and style of the Indestructible Phonographic Record Company, are defendants, I was attended at the office of Frank L. Dyer, Edison Laboratory, Orange, N. J., by Melville Church, Esq., and Dyer Smith, Esq., counsel for complainants, as also by Walter A. Scott, Esq.,
271 counsel for defendants, on the several days and dates hereinbefore stated; that the aforenamed witnesses, Stephen C. Porter, Arthur S. Browne and William F. Messer, who were of sound mind and lawful age, and were by me first carefully examined and cautioned and duly sworn to testify the truth; the whole truth and nothing but the truth; and they thereupon testified as is above shown, and that the depositions by them subscribed, as above set forth, were reduced to typewriting by me (1) in the
272 presence of the witnesses themselves and from the statements of them, and were subscribed by the said witnesses in my presence, and were taken at the place in the annexed notice specified and at the times as set forth, adjournments being had or taken from day to day as provided for in said notice, and that all was so done, written and signed in the presence of said counsel for said complainants and defendants. I further certify that the reason for taking said depositions was, and is, and the fact was, and is, that all of the deponents live more than one hundred miles from the

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place where the civil issue is appointed by law to be tried; that I am neither of counsel nor attorney to either of the parties to said suit, nor interested in the event of said cause, (2) and that it being impracticable for me to deliver said depositions and the exhibits thereto attached with my own hand into the court for which they were taken, I have retained the same for the purpose of being sealed up and directed with my own hand, and speedily and safely transmitted to the said court for which it was taken, and to remain under 274
my seal until there opened. (3)

As witness my hand and seal as such examiner at Orange, New Jersey, on this 13th day of January, 1910.

Anna R. Klehm,
[Seal.] Notary Public,
State of New Jersey,
Commission expires June, 1913.

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IN THE UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF NEW YORK.

NEW JERSEY PATENT COMPANY and NATIONAL PHONOGRAPH COMPANY, Complainants, 278 vs. GEORGE G. SNOWDEN, JAMES H. SNOWDEN and HENRY McSWEENEY, doing business as a co-partnership under the name and style of the Indestructible Phonographic Record Company, Respondents. 279	In Equity No. 7240. Letters Patent No. 713,209.

Deposition of ARTHUR S. BROWNE, a witness examined in behalf of the complainants in rebuttal, pursuant to notice, before ANNA R. KLEHM, a Notary Public in and for the State of New Jersey, at the Edison Laboratory, Orange, N. J., on August 8th, 1910.

Present:

280 DYER SMITH, ESQ., and MELVILLE CHURCH, ESQ., on behalf of complainants.

WALTER A. SCOTT, ESQ., on behalf of defendants.

ARTHUR S. BROWNE having been duly sworn in the cause, deposes and says in answer to questions proposed to him by Mr. Church, as follows:

Q. 1. Are you the same Arthur S. Browne who has heretofore been examined as a witness for the complainants in this cause?

A. I am.

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Q. 2. Have you read and do you understand the
deposition given by defendants' expert, Mr. Carter, in
this cause, as well as the patents of the prior art re-
ferred to by him in the said deposition, and if you
have, will you please compare such prior art patents
with the process of duplicating phonograms set forth
in the Edison patent No. 713,209 in suit, as particularly
referred to in claims 2, 3, 4, 5, 9, 10, 13, 16 and 17
thereof and state the result of such comparison? In
giving your answer, I request that you make such crit- 282
icisms of the testimony of Mr. Carter respecting such
patents as you may deem pertinent in your discussion
of them.

A. I have read Mr. Carter's deposition and the several prior patents to which he has referred, and understand the same.

These prior patents do not disclose the subject
matter of any of the claims of the Edison patent in
suit, mentioned in the question. As I understand Mr.
Carter's deposition, he only asserts that the subject 283
matter of these claims is disclosed in the British pat-
ents of Lioret No. 23,366 of 1893 and of Young No.
1478 of 1894, and in the Lioret U. S. patent No. 528-
273, October 30, 1894, and, as to these patents I do
not agree with Mr. Carter as to what is disclosed in
them, as I will explain when I take them up for detail
consideration.

So far as the prior art shows, the Edison patent in
suit is the earliest instance of a disclosure of a method
of making duplicate phonograph records or "phono- 284
grams" wherein there is employed a hollow cylindical
mold or matrix having a reverse phonogram record on
its inner wall into which the material of which the
duplicates are composed is inserted and is forced
against the irregular matrix surface to receive an im-
pression therefrom, the thus molded duplicates being
removed from the mold by shrinkage, due to cooling,
followed by longitudinal separation. Not only was
this method of making duplicate phonograms first dis-
closed in the Edison patent in suit, but, indeed, the

285 prior art fails to disclose any instance in any art of the employment of an integral hollow cylindrical mold having an irregular and unsymmetrical internal molding surface from which the molded article is removed after shrinkage by a direct longitudinal movement.

I will consider the various prior patents referred to by Mr. Carter for the purpose of establishing the correctness of the statement just made.

Edison No. 484,582 October 18, 1892. The applica-
286 tion for this patent was filed January 30, 1888, and is the earliest patent referred to by Mr. Carter, which discloses a method of duplicating phonograms. In accordance with this patent a hollow cylindrical metallic matrix or mold was made, as shown in Fig. 4. The procedure which is then employed is thus described in the patent :

> "This metal cylinder is then split longitudinally by a very thin saw into a number of parts
> 287 —say, for illustration, three parts—which are suitably mounted upon levers, so that a mold is formed, which can be closed to receive the material to be molded and opened to permit of its being taken out. The duplicate phonograms are produced by means of this mold by pouring therein and preferably around a suitable core placed in the mold suitable substances, such as wax or wax-like material, resin or plaster-of-paris, the material being prefer-
> 288 ably too hard to be satisfactorily indented by the phonograph or the duplicate phonograms may be made by taking sheets of smooth material, like waxed paper or tin foil, and pressing them upon the surface of the mold by a plunger or otherwise, the sheets being afterward backed up by a wax, resin or cement." (Page 1, lines 69-88.)

In accordance with this patent, the metal mold is sawn into sections, so that, after a duplicate has been

289 molded, the mold can be separated and opened out, so as to permit the removal of the molded record. Such a plan is wholly impracticable because the sawing of the mold into sections necessitates the removal of some of the metal on which the sound waves are represented, thereby destroying a portion of the sound irregularities, and causing imperfection in the duplicated record. It is entirely obvious that this patent wholly fails to disclose the method of the patent in suit ; and, moreover, it further shows that Edison 290 then had no conception of the possibility of obtaining duplicate molded records from an intact cylindrical mold. This patent, however, is important, since it was before the world for over five years before the filing of the application for the patent in suit and it suggested to no one the possibility of making molded duplicate records in the manner disclosed by the patent in suit.

Edison No. 382,417, May 8, 1888 : The application for this patent was filed February 4, 1888, only a few 291 days after the filing of the application for the split mold patent, No. 484,582, and it affords contemporaneous evidence that the possibility of obtaining duplicate sound records from an integral cylindrical mold would not obviously occur to any one familiar with obtaining a molded article with a smooth surface from a mold having a smooth symmetrical molding surface. The purpose of this Edison patent No. 382,417 is to make blank phonograph cylinders with smooth cylindrical surfaces, which are to be subsequently used in a 292 phonographic machine in order to have a sound record cut therein. In this connection, the specification says :

> " The object I have in view is to produce a method or process of making wax phonogram-blanks which will result in a more accurate blank and one having a better surface for receiving the phonograph-record." (Lines 9–13.)

In accordance with this patent a mold or die F is employed, into which a roughly cast cylindrical

293 blank is inserted while it is still of sufficient temperature to be plastic; and against the interior surface of this die the blank is forced by means of a tapering mandrel or plunger. The specification says:

> "The die and its plunger are made of highly-polished metal. Speculum metal is preferably used for this purpose." (Lines 74–76.)

294 "Speculum metal" is an alloy such as is used in reflecting telescopes and which can receive a sufficiently bright polish to serve as a mirror.

The patent does not explain any details concerning the removal of the finished blank. All that is said is that the blank is pressed against the walls of the surrounding die and that—

> 295 "The plunger is then removed from the blank and the blank removed from the die, when it will be ready for use on a phonograph." (Lines 77–80.)

There is nothing here to suggest that there is any chilling of the blank following the molding of the record. Indeed, the inference is that there is no chilling, but that removal immediately follows molding. The description just quoted treats the removal of the plunger and of the blank as immediately following the molding and there is no suggestion of any use-
296 ful time interval. Manifestly, the plunger must be removed while the blank is at its molding temperature, since any chilling of the blank would cause it to cling to the plunger. The high-polish given to the plunger (as well as to the die as the patent describes) facilitates the withdrawal of the plunger from the still warm blank, and with equal facility the blank can be withdrawn from the highly polished die while still warm.

The patent is wholly silent as to any utility to be derived from waiting until the blank chills; and wholly fails to indicate any realization on the part of the patentee that chilling the blank with the resulting contraction is a utilizable factor in removing the blank. Much less does the patent disclose the possibility or feasibility of utilizing a mold with sound irregularities for obtaining duplicate records by molding and utilizing shrinkage due to cooling as a factor in removing the molded record from the mold. 297

In connection with this blank molding patent Mr. Carter says— 298

> "This patent does not state that the contraction of the blank, due to cooling, loosens it in the matrix and permits it to be readily withdrawn, but of course this would be the natural and normal action, the blank having been inserted while warm."

Mr. Carter here assumes that the patent contemplates a period of delay subsequent to molding, during 299 which cooling can take place; but nothing of the sort is described in the patent, and on the contrary, so far as the disclosure goes, no opportunity for cooling is given. The plunger must be withdrawn before any appreciable cooling takes place, and the patent describes the withdrawal of the plunger and the withdrawal of the blank in the same breath. Moreover, the high-polish of both die and plunger facilitates the withdrawal of the plunger from the blank and of the blank from the die while the die is still warm. 300

On the basis of an assumed cooling and consequent contraction of the blank, Mr. Carter reaches the conclusion that the process of the patent in suit is essentially the process of this blank molding patent, except for the difference in the matrices. Referring to the two cases disclosed in the two patents Mr. Carter says:

> "Assuming the selection of the proper matrix, the subsequent steps were the same in the two

301

> cases, and the difference in the product was wholly due to the difference in the matrix."

I disagree both with the statement of fact and the conclusion drawn therefrom. In the patent in suit there must not only be a shrinkage of the molded duplicate, due to cooling, but that shrinkage must be of a character which does not disturb the faithful reproduction of the sound irregularities, and also it must be
302 sufficient to enable the irregular external surface of the molded duplicate to clear the interior irregular face of the mold. Nothing of the sort either in kind or extent is disclosed in the blank molding patent No. 382,417, or is incident to the practice of the process thereof.

Moreover, assuming that this Edison blank molding patent No. 382,417 did disclose an intelligent use of shrinkage due to cooling for the purpose of facilitating the withdrawal of the molded blank from the die, it is
303 evident that it taught nothing to the public concerning the usefulness of such shrinkage in connection with making duplicate sound records. This blank molding patent was granted nearly ten years before the filing of the application for the patent in suit and no one realized during that period the suggestiveness thereof which Mr. Carter now discovers twelve years after the application for the Edison patent in suit and nearly eight years after its grant.

Edison No. 526,147 September 18, 1894 : This patent
304 discloses nothing in connection with making duplicates of phonograph records. Indeed, it does not mention the subject of phonographs at all. It is directed to the "art of plating one material with another" and the only specific uses it mentions are for coating mirrors (page 1, lines 56 and 101, and line 60 page 2), reproducing in metal the "tracery of lace" (page 1, line 84), and plating "hooks and eyes, or small articles of jewelry" (page 2, lines 53-54). The application for this patent was filed January 28th, 1884, and the number of the application was 118,942, and the split mold

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patent No. 484,582 (already considered) refers thereto
at line 23, page 1, as showing a step which can be em-
ployed in making a matrix from an original sound
record. Otherwise, this "vacuous deposit" patent
No. 526,147 has no revelance.

Appelt, No. 303,970 August 26, 1884: The object of
of this patent is to make the drawing rollers employed
in spinning machinery and the like with elastic sur-
faces. The purpose of drawing rollers in spinning
machines is to elongate or draw out the loose "roving" 306
of the fibre (cotton, wool, silk or the like) preparatory
to the twisting action of the spindles, so as to regulate
the fineness of the thread or yarn. It would never
occur to any one seeking how to make duplicate
phonographic records to investigate the mechanism
employed for determining how the fineness of thread
or yarn is regulated in spinning. In any event, how-
ever, this Appelt patent is irrevelant. The object is
to get "a perfect smooth and cyndrical surface" (page
1, line 22) made of "gelatine, glycerin, and other more 307
secondary ingredients" (page 1, line 14) and to this
end the composition is molded in a tube which "is
bored out exactly cylindrical and smooth" (page 1, line
33). The object is to mold a symmetrical article in a
symmetrical mold. It would never suggest to any one
the possibility or feasibility of using such a method in
making duplicate sound records by molding them in
a matrix having an irregular surface.

Potter, No. 434,294 August 12, 1890: This patent
is for "shaping cast steel" and the only uses for 308
which the method is described are in connection
with the making of "steel cannon" (page 1, line 17)
and "shafting" (p. 1, line 22). The molding em-
ployed is symmetrical and a symmetrical article is cast
therein. What I have just said with respect to the
Appelt drawing roller patent applies to this steel
casting patent.

Day, No. 563,572 July 7, 1896: This patent is for
making printers inking rollers, and the purpose is to
make a readily replacable roller having "good ink-

309 taking qualities" (page 1, line 16). Such inking rollers have their surfacing material commonly made of a glue-like composition and the specification says that for fine work he uses a composition made of gelatine and glycerin (page 1, line 88). In making such rollers a cylindrical symmetrical mold is made and the intent is to make a smooth cylindrical roller. What I have said with respect to the Appelt drawing roller patent applies equally to this inking roller patent.

310 It would never occur to any one wishing to mold a phonographic record by means of a matrix having an irregular surface to examine such remote arts to find out how smooth symmetrical articles had been molded in symmetrical molds. Moreover, the remaining patents of the prior art to which Mr. Carter has referred show that remote arts of this character taught nothing to inventors seeking to make duplicate sound records. If such remote arts contained any suggestiveness as Mr. Carter in 1910 thinks they have, the progress of the art of duplicating sound records should exhibit their influence. The contrary is the case. 311

Adjourned to Wednesday, August 9th, 1910, at 10:15 A. M.

ORANGE, N. J., Aug. 10, 1910.

312 Met pursuant to adjournment.

Present: Parties as before.

MR. BROWNE continues as follows:

Lioret, No. 528,273, Oct. 30, 1894: and (British) No. 23,366, December 5, 1893: These Lioret patents describe a method of making duplicate phonograph records, and they fail to disclose the subject matter of the pertinent claims of the Edison patent in suit, and they also fail to show that Lioret obtained any informa-

313 tion from the patents preceding them which Mr. Carter now finds so suggestive.

These two patents of Lioret are directed to the same invention.

Lioret first filed a "provisional specification" in Great Britain on December 5, 1893.

He then filed his application for the United States patent on December 20, 1893.

Subsequently on September 5, 1894, he filed his complete specification in Great Britain, which was accepted 314 October 13, 1894.

His United States patent was issued October 30, 1894.

The two British specifications and the United States specification have some differences. The drawings of the British provisional specification are the same as those of the United States specification. The United States specification contains a detail description of how the duplicated records are removed from the mold, which is not explained in either British specifi- 315 cation. The British complete specification includes an additional sheet of drawing containing two figures, 8*a* and 21, which are not in the United States patent or in the British provisional, and the British complete specification contains explanations of these two figures at lines 26 to 37 of page 7, and at lines 35 to 45 of page 8, which are not in either the British provisional or in the United States specification. One of the new features introduced in the British complete specification is the employment of an expanding pneumatic 316 mandrel to distend the celluloid tube against the matrix.

Except for these differences the three specifications describe substantially the same invention.

Lioret's fundamental purpose is to construct a toy phonograph suitable for childrens' dolls. I quote from the United States specification as follows:

> "The object of my invention is to construct phonographs at a low price and consequently

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> provide for their application to very numerous purposes, such for instance, as the manufacture of new toys" (page 1, lines 9–13).
>
> "In the following descriptions of examples of my invention I will suppose the phonograph arranged in the body of a doll as shown in Fig. 9, but it will be understood that it is capable of any other application" (page 3, lines 6–10).

318 Both patents are largely devoted to description of clock-work mechanism which is used to rotate the phonographic record when mounted within a doll.

In such a toy, accuracy and clearness in reproduction is of minor consequence as compared with durability. Accordingly, the patents specifically describe the manufacture of phonograph records of great durability. In this connection the United States patent refers to "its great hardness assuring it the advantage, quite new, of great durability" (page 2, line 27); and 319 the British patent says that "its great durability will thus insure the advantage of a very long life, which is quite new" (page 6, line 38).

Accordingly, in carrying out this fundamental and primary purpose of the invention, Lioret makes a steel phonographic record. His U. S. patent says:

> "I take a sleeve or hollow cylinder of soft steel having on its outer circumference a thread with triangular cross-section of suitable fineness 320 and place it in front of the recording style attached to the vibrating plate or diaphragm which is spoken against, so arranging the said sleeve and style that the point of the style engraves its impressions successively along the top angle of the thread; this being where the resistance to penetrate is the least, first because of the slight thickness of metal presented and second, by reason of the absence of lateral contact or friction due to contiguous surfaces because such surfaces do not exist in the neigh-

321

> borhood of the top angle of the thread; where the style may act with more efficacy and cut in a suitable manner in the sharp edge the impressions which are to be left upon the cylinder." (Page 1, lines 63–82.)

Substantially identical passages are in the two British specifications, beginning at line 34, page 1, and at line 50, page 5, respectively of the patent.

322 After the phonographic record has been made on the sharp angles of the screw thread, the steel cylinder is then hardened and is then ready for use in the doll.

Superposed upon this foundation invention is a method of making duplicate records from this steel record. The steel record with the sound indentations in the sharp edges of its screw threads is used as a pattern for the making of the galvano-plastic mold *a'*, as shown in Figs. 5 and 6. This mold is a hollow cylinder having a screw thread on its interior with irregular indentations corresponding to the sound waves. 323 Lioret contemplates that the sound impressions may be engraved either at the top or at the bottom of the screw threads and the mold would have the indentations either at the top or bottom of its screw threads correspondingly. In this connection, the U. S. patent says:

> "It may be understood moreover that according as the impressions have been engraved upon the angle or in the bottom of the thread of the 324 matrix *a*, the cylinder *c* will also have the impressions upon the angle or in the bottom of its thread and that the receiver style should be formed to correspond." (Page 2, lines 131–133 and page 3, lines 1–5.)

It will be noted that Lioret thus contemplates making a metallic mold by electroplating a metal cylinder upon the steel sound record, but he does not ade-

325 quately explain how the two are to be separated. They are united together by the intermeshing screw threads and the inter-engaging sound indentations; and this engagement is of the most intimate character, owing to the electro-deposition of the metal of the mold upon the steel sound record. This deficiency in disclosure Mr. Carter supplies by suggesting that "by judiciously applying a flame to the exterior of the mold while running cold water through the interior of the record
326 cylinder, if necessary, the temperature difference could be made almost anything desired" and hence the two could be sufficiently separated to enable them to be taken apart; or that "it would obviously be possible to dissolve out the original steel record from the galvano-plastic mold by the use of appropriate acids, which would attack the steel alone, leaving the copper unharmed, in exactly the same manner as the original wax record is dissolved out of the mold in the Young patent, or of the Edison patent of October 18, 1892."
327 The Lioret patent contains no such explanation. I do not understand Mr. Carter's reference to the Young and Edison patents. I fail to find in either any reference to dissolving the original wax record out of the mold by the use of any acid. I assume he means the Young British patent No. 1478 of 1894 and as this is subsequent to the Lioret patent, it cannot possibly have been meant by Lioret as an aid to his disclosure. What Young describes as his way of getting his wax record out of his mold is by
328 melting it out and not by the use of an acid. I assume that the Edison patent referred to by Mr. Carter is No. 484,582. All this Edison patent says concerning the removal of the wax record from the mold is that "The material of the original phonogram is then dissolved off of the metal covering" (page 1, line 64), but how this dissolution is effected the Edison patent does not explain. Mr. Carter thus uses the inadequate disclosure of Edison to supply a total omission in Lioret.

329

What Lioret says concerning the removal of the mold from the phonographic steel record is simply:

> "I remove this tube from the matrix cylinder by first heating it internally to expand it sufficiently to enable it to be unscrewed from the said cylinder, the impression being so slight that very little expansion is necessary." (Page 2, lines 92–97).

330

The difficulty of doing this is because of the very slight difference in expansion between the steel record and the electroplated surrounding mold and the close adherence between the metal surfaces. Mr. Carter suggests that "any tendency for the metals to adhere to each other could be readily overcome by applying a suitable coating to the cylinder before electroplating it, in accordance with the familiar practice of the electroplating art." But Mr. Carter does not explain how any such interposed coating is to be consistent 331 with the faithful reproduction of the sound indentations, and nothing of the sort is suggested in the patent.

Assuming, however, that the difficulties are overcome, Lioret then proceeds with his mold or tube as thus described in the U. S. patent:—

> "After its removal I introduce into the said tube a sleeve or ring *c* of celluloid (see Fig. 7) just large enough to enter it freely, then plunge the whole into hot water. The celluloid is thus 332 softened, and I then introduce forcibly into the said collar or ring *c* a mandrel a^2 sufficiently large to dilate the said ring or collar and cause it to penetrate into all the cavities of the mold a' as shown in Fig. 8. I then plunge the whole into cold water and the celluloid recovers its hardness and is at the same time generally contracted sufficiently to permit the easy withdrawal of the ring *c* from the mold a' by unscrewing it therefrom." (page 2, lines 97–111).

333

This fundamentally differs from the process of the Edison patent in suit, because it is necessary to remove the celluloid duplicate from the mold by unscrewing it therefrom. Such an unscrewing method would be wholly impracticable with commercial sound records. The pitch of the spiral sound record is very small, there being about 100 threads to the inch, and it would thus take several hundred turns to unscrew a duplicated record
334 from a matrix, and this would not only be slow but would endanger damaging the duplicate record.

In this connection Mr. Carter calls attention to the fact that the Lioret British specifications do not describe this unscrewing which is in the United States patent alone. This is simply due to the circumstance that the description in the British specifications relating to the making of the celluloid duplicates is much briefer and less specific than in the U. S. patent. For example, the description which is contained at lines
335 14 to 24 of page 7 of the British specification is expanded into lines 84 to 131 of page 2, of the United States specification, and although the British lines are longer, nevertheless the U. S. description is much fuller. For example, the British patent does not contain any explanation of how the electroplated mold is removed from the steel record. Likewise, it does not explain how the celluloid duplicate is removed, simply saying :

336

> " It is then plunged into cold water and the celluloid again hardens, at the same time contracting sufficiently to enable the sleeve *c* to be easily withdrawn from the tube *a*." (Page 7, line 23.)

How this withdrawal is effected the British specification does not explain, but the U. S. specification adds " by unscrewing it therefrom " as at the close of the extract just quoted from page 2, lines 97 to 111.

337 This unscrewing is further emphasized in the following passage from the U. S. specification :

> " It may be here mentioned that the impression produced by the style on the matrix cylinder and reproduced in reverse in the mold *a'* is so slight that only a very slight dilation of the ring *c* is necessary to obtain the impression on it and a very slight contraction to permit it to
> be unscrewed from the mold *a'* without damag- 338
> ing said impression." (Page 2, lines 116–123.)

The Lioret patents thus fail to disclose the subject matter of any of the pertinent claims of the Edison patent in suit, because the duplicate records are not withdrawn by direct longitudinal movement but require unscrewing; and because the radial contraction of the duplicates is not sufficient to clear them from the interior surface of the mold.

339 Furthermore, Lioret does not explain how he avoids the effects of longitudinal contraction. Lioret provides for some contraction due to cooling and there will hence be longitudinal as well as radial contraction. The effect of longitudinal contraction will necessarily cause the faces of the spiral thread of the molded record to bind upon the spiral thread of the screw-threaded mold, thus increasing the difficulty of unscrewing the record without damaging it.

Again, Lioret gets the necessary heat to render the
celluloid ring moldable by plunging the external mold 340
and the celluloid ring into hot water, as shown in Fig. 8, and then forcing the softened celluloid ring outwardly as illustrated in the same figure. Any such procedure as this would cause water to be trapped in the spiral space between the celluloid ring and the mold and would hence interfere with the proper formation of the record. In this connection Mr. Carter attempts to supply the deficiency of the Lioret disclosure by saying " that it would be a simple-minded mechanic

341 indeed to whom, if he found any difficulty of this kind, it would not instantly occur to temporarily seal the joint between the ends of the mold and the matrix, as by a suitable insoluble wax, so as to prevent the water from entering the crevice. A more obvious expedient, in fact, can hardly be conceived of, or one more certain to overcome a suggested difficulty." The difficulty with Mr. Carter's additional improvement is that it would trap the air between the mold and the celluloid
342 ring, which would equally prevent the making of a proper duplicate.

The disclosure in the Lioret patent is wholly inadequate to enable duplicate records to be efficiently made in accord with his plan.

Not only do the Lioret patents fail to disclose the subject matter of the pertinent claims in suit, but they show that the preceding prior art was inadequate to show Lioret a proper method or to make it evident to him that it would be possible to rely upon shrinkage
343 alone, due to cooling, as enabling the molded record to become entirely clear of the mold so as to permit of the withdrawal of the molded record by a direct longitudinal movement.

Young (British), No. 1478, January 23, 1894: This is another project for making duplicate phonographic records. This patent likewise fails to disclose the subject matter of the pertinent Edison claims and shows the inadequacy of the preceding prior art to teach Young that it was possible by shrinkage alone,
344 due to cooling, to get the molded records clear of the mold, so as to permit removal by a direct longitudinal movement.

The provisional specification of Young was filed January 23, 1894, less than two months after the filing of the provisional specification of the Lioret British patent (just considered), and Young's complete specification was filed September 27, 1894, 22 days after the filing of the Lioret complete specification and 16 days before the acceptance thereof.

345 Young's complete specification was accepted October 27, 1894, 14 days after acceptance of the Lioret complete specification.

The two Young specifications are substantially the same, and identically the same so far as the making of the duplicate records of celluloid, or the like, is concerned. It will, therefore, suffice to refer to either of the Young specifications.

The important differences between the Young
346 method of making the duplicates in the mold from the Edison patent in suit are, (1) that Young uses a celluloid blank so very thin that it is rendered *pliable* as well as *plastic* by the heat, as contrasted with Edison's blank which is "of sufficient thickness to maintain its shape during and after its engagement with the matrix" as recited in claim 4, and in substantially the same language in claims 9, 10, 13, 16 and 17, of the Edison patent in suit; and (2) that Young has to collapse his very thin celluloid duplicate in order to get
347 it out of the mold.

In this connection Young says that when the thin cylindrical blank of celluloid or the like "has been rendered *pliable*, by a gentle heat (which may be that given off from the heated electro and its casing) I press the same gently and evenly up to and against the face of the electro, and take an exact impression therefrom and when the said *plastic* cylinder has cooled, I am enabled, by slightly *collapsing* this inwardly, to cleanly and easily remove it from the electro."

348 Young, thus had no conception of the possibility of using a blank of such character that its shrinkage alone, due to cooling, would suffice to cause its impressed surface to become entirely clear of the irregular surface of the mold, thereby permitting withdrawal by direct longitudinal movement. Young is obliged to use a celluloid blank so thin and pliable that it can be collapsed to enable it to be withdrawn.

Mr. Carter attempts to make the Young patent material by assuming that Young did not use the word

349 "collapsing" intelligently. In this connection Mr. Carter says:

> "The quotation does not use the words 'shrinkage' or 'shrinking', but speaks of cooling the blank and collapsing it inwardly to release it from the mold, and it is evident that the collapsing referred to is simply a clumsy statement of the contraction which
> 350 necessarily results from the cooling of the celluloid, and inevitably draws it inwardly away from the surface of the bore of the matrix, so that it can be removed endwise therefrom."

Mr. Carter's notion seems to be that Young intended to say that the cooling alone suffices to cause the celluloid duplicate to clear the mold and that he uses the word "collapsing" to refer to the contraction due to cooling. It is manifest, however, that Young states
351 the matter just the other way. Young does not state that the cooling alone is sufficient to enable the removal to be accomplished. On the contrary he says that "when the said plastic cylinder has cooled, I am enabled, by slightly collapsing this inwardly, to cleanly and easily remove it from the electro." That is to say after the cooling, Young is enabled to perform another act, namely, to collapse the record. The collapsing is described as an additional step which Young is enabled to perform after the cooling has been effected. This
352 is in accord not only with what Young says but with the ordinary meaning of the word "collapse." As Young was an Englishman, I quote from an English dictionary namely, "The Imperial Dictionary of the English language," published in London in 1883 by Blackie & Sons, 49 and 50 Old Bailey, E. C.:

> "*Collapse* ('kol-laps') v. i. pret. & pp. *collapsed;* ppr. *collapsing.* (L. *collabor*, *collapsus*, to fall together, to fall in ruins—*col* for *con*, and *labor*, to slide or fall). 1. To fall in or

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> together, as the two sides of a vessel; to close by falling together; as, a bladder when emptied of air *collapses.*
>
> In consumptions and atrophy the liquids are exhausted and the sides of the canal *collapse.*
>
> ARBUTHNOT.
>
> 2. Fig. to come to nothing; to break down; as the project *collapsed.*" 354

When thus using the word "collapsing" in its ordinary significance (and so far as I know its only significance) it is evident the process described by Young involves letting the record and mold cool sufficiently to be handled, and then as a subsequent operation collapsing the record so as to get it out of contact with the mold sufficiently to enable it to be withdrawn.

Mr. Carter refers to certain experiments made by him to ascertain the character of the Young process, but it is evident that he did not practice the process of the Young patent. In his experiments he says that: 355

> " And in every case, upon then being allowed to cool, the cylinder contracted, collapsed, shrunk, or whatever it may be called, so as to free itself from engagement with the bore of the matrix. This collapsing or shrinkage occurred solely as a result of the cooling of the blank and without any action or volition on my part, or on the part of any other person present at the time. And it occurred without in any way changing the essential cylindric shape of the blank. There was no buckling or bending of the blank whatever." 356

Manifestly, Mr. Carter did not do what the patent tells him to do. The shrinkage which he got (" collapsing ", as he chooses to call it) " occurred solely as

357 a result of the cooling of the blank and without any action or volition on my part, or on the part of any other person present at the time." This is not Young's mode of procedure, because, as he describes it, some action or volition on the part of the manipulator was necessary after the cooling, because Young says that when the record has cooled "I am enabled, by slightly collapsing this inwardly, to cleanly and easily remove it from the electro".

358 Mr. Carter was enabled to follow a different procedure either because he used a thickness of material beyond what Young contemplated, or because he used other methods not described by Young. Mr. Carter used celluloid about eleven one-thousandths (.011) of an inch thick (about three times as thick as an ordinary sheet of writing paper) and thus apparently much thicker than the thin material contemplated by Young; and he softened the celluloid by steaming at a pressure from 30 to 40 pounds per square inch, and ultimately
359 pressed the blank by introducing compressed air under pressure of about 80 pounds per square inch, a method of procedure wholly without foundation in the Young patent.

As a matter of fact, Young does not describe how he applies pressure. All he says is "I press the same gently and evenly up to and against the face of the electro". All that this describes is that by some personal act, such as might be done with the hand by a tool, he applied pressure to the interior of the cellu-
360 loid blank. I do not know of any other way known in the art at that time which could have been employed. Young says that his blank is in the form of "a very thin hollow cylinder" and accordingly he could not have used a tapered mandrel, such as is shown in the Edison patent No. 382,417 May 8, 1888 (already considered), because that requires that the blank should have a tapered bore and hence must be of unequal thickness. Mr. Carter refers to another experiment in connection with trying the process of the Young patent, in which he states that he used an arrangement which served

361 "in effect, as the rubber-covered fluid pressure expander shown in Fig. 8*a* of the British patent to Lioret." There is no justification, however, for assuming that Young contemplated any such pneumatic expanding mandrel because Young's process in connection with the celluloid or other like blank was contained in his provisional specification filed Jan. 23, 1894, whereas, the Lioret specification and drawing disclosing his pneumatic expanding mandrel were not filed until September 5, 1894, more than seven months 362 after.

It can only be conjectured, therefore, how Young proposed to apply pressure to his celluloid blanks.

I note that Young in his complete specification disclaims the Lioret British patent No. 23366, but this disclaimer was not in the provisional at all. British specifications are not accessible until after acceptance, and as Lioret's complete specification was accepted two weeks before that of Young, it may not be an unfair inference that Young's disclaimer was required by 363 the British Patent Office before his complete specification would be accepted.

The Young patent thus fails to disclose the subject matter of the pertinent claims of the Edison patent in suit, because he does not have a record which maintains its shape during disengagement from the mold or matrix, but has one so thin that it is disengaged by collapsing; and because he does not disengage his duplicate records from the mold simply by shrinkage, due to cooling, so that after the cooling the records 364 can be withdrawn by direct longitudinal movement.

It is furthermore manifest that nothing in the preceding prior art was suggested to Young to enable him to reach the Edison invention.

Looking at the matter backward from the standpoint of realized success, it may seem that it should have been inevitable that those skilled in this art should have appreciated that with the proper material for the duplicate records, they could shrink enough on being adequately cooled, to enable them to thereby become

365 disengaged from the irregular matrix surface so as to permit direct longitudinal withdrawal without damage. But this did occur to no one but Mr. Edison, although the record shows that there were others in the art (presumably skilled) who were endeavoring to get duplicates and who nevertheless did something different and inadequate.

For these reasons, I am of the opinion that the subject matter of each of the pertinent claims (mentioned 366 in the question) of the Edison patent in suit, is novel and substantially so.

Q. 3. State whether or not you regard defendants' exhibit, Record 3012-H, such as is contemplated by the Edison patent in suit, giving your reasons for any opinion you may express?

A. Assuming that this sample record is a phonographic record, capable of reproducing sound, I understand it to be a record such as is contemplated by the Edison patent in suit. It is made of celluloid which 367 is one of the materials mentioned in the Edison patent, and from inspection I should regard it as sufficiently thick to maintain its shape during and after disengagement from the matrix in which it was molded. This exhibit has turned-over end flanges to enable it to fit the usual mandrel of a reproducing phonograph and which may add somewhat to its stiffness, but irrespective of these flanges, I should regard it as sufficiently thick and stiff to enable it to be disengaged from the matrix without involving any such pliability 368 as would require it to be collapsed to enable it to be withdrawn.

Q. 4. How do the paper backing and metal rings act in the complete records of defendants' manufacture, like "Defendants' Exhibit, Defendants' Finished Record, No. 3094, Band Isabella Overture," as you understand it?

A. I understand that they act to make the internal bore of the record sufficiently small so as to enable it to fit the rotating mandrel of the ordinary commercial phonograph.

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Q. 5. State whether or not you have ever made any tests to demonstrate the applicability of the invention of the patent in suit to the production of sound records from celluloid, and if so, state what you have done in that connection?

A. On January 10, 1910, I did make a test of the process of the Edison patent in suit in making a celluloid record at the factory of the National Phonograph Company in Orange, N. J. and I here produce a sample celluloid record then made. The celluloid blank had a 370 slightly tapering bore and it was placed within a mold having a sound record on its inner surface and a tapering mandrel was then inserted within the celluloid blank fitting the same. The mold, blank and mandrel were then heated to soften the celluloid. The mandrel was then forced further into the celluloid blank, thereby expanding it outwardly against the matrix surface, this being done in a screw press. After this was done, the mandrel was withdrawn, and the mold with the celluloid record was then cooled. It 371 being a cold day in January, this was done by placing the mold and the contained record outside the window of the room. When the mold and record were cooled, the celluloid record had shrunk so that it was clear of the mold and it was removed by being drawn out by direct longitudinal movement.

The celluloid record thus made was too thin to fit one of the ordinary phonographs and accordingly in order to make it fit the same, a lining was inserted made of the ordinary soap composition which is used 372 for making original records.

I tested the record thus made at the time on a phonograph and again tested it to-day on the phonograph. It is a good record. I estimate that this celluloid record is about one-sixteenth of an inch thick on the average.

> Counsel for complainants here offers in evidence the celluloid record produced by the witness and the same is marked "Complainant's Exhibit, Brown-Edison Celluloid Record".

373

Q. 6. Please state whether or not you have ever practiced the process of the Edison patent in suit with other record material beside celluloid, and if so, state what you have done?

A. At the time and place stated in the preceding answer I made another record in just the same way out of the ordinary soap composition which has been employed for many years by the National Phonograph Company in making original records; the only difference 374 being that the material employed was sufficiently thick to fit the mandrel of an ordinary phonograph without any extra lining. I tested this record at that time and again to-day on a phonograph. It is a good record. I here produce it.

> Counsel for complainants here offers in evidence the record last produced by the witness and the same is marked "Complainants' Exhibit, Browne-Edison Soap Record".

375

Adjourned to Thursday, August 11, 1910, at 10.15 A. M.

ORANGE, N. J., August 11, 1910.

Met pursuant to adjournment.

Present: Parties as before.

CROSS-EXAMINATION OF THE WITNESS BY MR. SCOTT:

376

x-Q. 7. Do you know what the co-efficient of expansion of celluloid of the composition used in phonograph records is?

A. No.

x-Q. 8. Do you know what the co-efficient of expansion is of the material of which the matrix was made which you used in making "Complainants' Exhibit, Browne-Edison Celluloid Record", and "Browne-Edison Soap Record"?

A. No.

377

x-Q. 9. What was your purpose in softening the celluloid by heat when you made "Complainants Exhibit, Browne-Edison Celluloid Record"?

A. In order to practice the process described in the Edison patent, which says that after the blank has been placed within the matrix and the mandrel has been inserted in the blank, "these parts are then subjected to heat" (page 3, line 30).

x-Q. 10. Is it your understanding that the application of heat in your experiments resulting in the pro- 378
duction of "Complainants' Exhibit, Browne-Edison Celluloid Record" effected any functions other than that of softening the blank as explained in the Young and Lioret patents, to which you have referred?

A. No, except that perhaps there may have been some molding effect as a result of the softening.

x-Q. 11. Please state what you mean by "molding effect"?

A. It is possible that the heating alone of the celluloid blank while confined between the mandrel and the 379
matrix may have resulted in some preliminary and partial conformation of the surface of the blank to the surface of the matrix.

x-Q. 12. What would cause such partial conformation of the blank to the matrix?

A. The expansion of the celluloid.

x-Q. 13. Expansion due to what?

A. Heat.

x-Q. 14. If the celluloid blank had not been held in a confined state between the mandrel and the matrix, 380
would the expansion of the celluloid resulting from heat have caused it to receive the impression of the interior of the matrix, or, would it have resulted in distorting the celluloid inwardly. In other words, which in your opinion, would have been the path of least resistance for the celluloid to take?

A. In reply to the first sentence of the question, I would say that I do not know.

As to the second branch of the question, my opinion

381 is that it would depend a good deal on the thickness of the celluloid. If the celluloid was so thick that its resistance to distortion exceeded the force required to partially conform its exterior surface to the surface of the mold, then there would be a partial molding effect and no distortion. On the other hand, if the celluloid was so thin that it would distort more readily than conform to the surface of the matrix, then distortion and not conformation would result. 382 Accordingly what would happen would depend upon the thickness of the celluloid blank.

x-Q. 15. Is the thickness of "Defendants' Exhibit, Defendants' Finished Blank" such that upon being placed within a matrix which fits quite closely, it would upon the application of heat expand outwardly sufficiently to take the impression of the interior of the matrix? I assume in my question that no mandrel is inserted in the blank.

A. I do not know.

383 x-Q. 16. I take it from your answer that you are unable to state whether defendants' blanks as exemplified in Defendants' Exhibit, Defendants' Finished Blank could be impressed with a phonographic record by the application of heat and the resulting expansion, and without the application of any other agency? Is this correct?

A. If your question means to refer to the complete impression on the blank, so that the completed record would give a faithful reproduction of the original 384 sound, I am of the opinion that the application of heat alone in the case of the exhibit, or one like it, would be inadequate. If, however, your question simply means to inquire as to whether or not there might be some impression of the sound irregularities on the blank as the result of heat alone without any internal pressure, I would say that I do not know and have had no experience on which I could base an opinion.

x-Q. 17. It would be impossible, would it not, to make a phonograph record from Defendants' Exhibit,

385

Defendants' Finished Blank, without first softening the celluloid by heat or some other agency? I refer, of course, to performing the operation by the engagement of the blank with a matrix.

A. Yes, so far as I know.

x-Q. 18. And the effect of the heat used for softening, in the absence of pressure derived from other sources would not be sufficient, as I understand you, to cause the blank to take the impression from the matrix by heat expansion; that is to take the impres- 386 sion to a sufficient extent to form a useable record?

A. It would not.

x-Q. 19. In the argument accompanying the amendment, dated September 1, 1898, to the application for the patent in suit, the following statement is made:

> "With the references the heating of the blank is performed for the purpose of making it plastic, so that the material of the blank may be afterwards displaced and caused to engage 387 the mold by the action of a mandrel, while with the Edison process the heating of the blank is performed solely for the purpose of causing it to expand into engagement with the matrix or mold."

In the argument dated July 6, 1898, filed in the Patent Office and accompanying an amendment to the application for the patent in suit, the following statements were made: 388

> "The heating of the blank as described by Lioret is effected solely for the purpose of making it soft in order that the mass may be displaced, so to speak, and be forced into the record contained at the bottom of the groove in the mold. With applicant's process the blank is heated for the sole purpose of causing it to expand and engage tightly with the record formed in the mold. Since perfect cylindrical molds

389 and blanks are used, the latter may be fitted within the mold within .002 (two one-thousandths) of an inch, so that the proper expansion of the blank may be secured without appreciably effecting the hardness and brittleness thereof."

Also that—

390 "The second British patent (the Young patent) makes it very clear that in the process described thereby, as well as in that invented by Lioret, the heating of the blank is performed solely for the purpose of making it plastic."

And finally that—

391 "It being the fact, therefore, that in neither of the references to which the Examiner directs applicant's attention is the heating of the blank effected for the purpose of expanding the blank into contact with the record, but is done solely for the purpose of making the blank plastic to enable it to be displaced and forced into contact with the record, it is clear to applicant that neither of the references is an anticipation of his invention."

392 In an affidavit made by Charles Wurth, an employee of the patentee, in support of the amendment of September 1, 1898, to the application for the patent in suit, the following statements are made:

"In carrying out the Edison process, I usually heat the blank after it has been inserted in the mold to a temperature of about 115° Fahrenheit, but this, of course, depends largely upon the character of the material of which the blank is made. This heating does not in any way affect the brittleness of the blank, nor does it make the blank plastic."

393 And again—

> " I have found that it is impracticable to heat a blank to the plastic point after its introduction into the mold, and particularly if the record is deep, as is obviously the case with a mold of the Lioret type having a record formed at the bottom of screw-threads, for the reason that when heated to plasticity, the blank will inevitably stick to the mold and it will in con- 394 sequence be impossible to obtain a perfect record. When, on the contrary, the blank is heated well below the point of plasticity as in the Edison process, and does not lose its friability, no difficulty of this kind has ever arisen."

And again—

> " The Young patent does not state how the 395 blank is to be engaged with the mold, but assuming that it could be evenly, accurately and simultaneously engaged with all parts of the record it would be possible to obtain a duplicate as described. It would not, however, be possible to remove the duplicate after it was obtained, since the heating of the blank to the point of plasticity would inevitably cause it to stick to the mold and thereby injure the record in whole or part." 396

And finally—

> " The essential difference between the Lioret and Young processes and the Edison process is that in the former the heating is effected for the purpose of making the blank plastic, so as to allow the material thereof to be distorted or displaced by the introduction of the mandrel. With the Edison process, the heating is done for the purpose of expanding the blank into en-

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> gagement with the record, and does not affect the brittleness of the blank. The test of the difference between the two is that with the Edison process it is possible to effect a satisfactory, though not loud, reproduction of the record by the use of the heat alone, the expansion being sufficient to cause the blank to engage the record and result in an impression. With the Lioret and Young processes, this would not be
> 398 possible, since the heating is always a necessary precedent to the subsequent displacement of the material by the use of a mandrel."

Mr. Edison himself also executed an affidavit on the same date as the Wurth affidavit, and which was filed with the same amendment of September 1, 1898. In this affidavit, he says :—

> "I have read the affidavit signed and executed by my assistant, Mr. Charles N. Wurth,
> 939 on even date herewith. The statements made by Mr. Wurth in reference to his experiments connected with my process and his criticisms of the processes described in the Lioret and Young patents are true, to the best of my knowledge and belief."

And quoting also from the amendment accompanying these two affidavits :—

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> "The Lioret and Young processes are different from that which Mr. Edison has invented, and particularly in the respect that with the references the heating of the blank is performed for the purpose of making it plastic so that the material of the blank may be afterwards displaced and caused to engage the mold by the action of a mandrel, while with the Edison process the heating of the blank is performed solely for the purpose of causing it to expand into engagement with the matrix or mold."

401

And again—

> " The claims which have been erased are can-
> celled in view of the fact that they appear to
> cover processes which are broader than appli-
> cant's invention, namely, processes wherein
> the blank, in the process of duplication, is dis-
> placed instead of being expanded. Neither the
> present first nor second claims is met by the ref-
> erences, for the reason that in the references the 402
> blank is not engaged with the mold by a change
> in temperature. In both the references, the
> heating of the blank is, as stated, performed for
> the purpose of making the blank plastic, and
> the engagement is subsequently effected by
> mechanical means."

Again in the argument accompanying the amendment of September 7, 1899, it is stated that—

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> " It is to be noted that they (Young and Lio-
> ret patents) do not meet the terms of the re-
> jected claims, since with both references the
> blanks are heated to the point of plasticity, and
> the engagement with the mold is effected by
> actually displacing the material of which the
> blank is formed. This is not the equivalent of
> applicant's step of expanding the blank into
> engagement with the mold, the blank being
> heated below the point of plasticity necessarily, 404
> because otherwise it would stick to the mold
> and would destroy the record if an attempt were
> made to withdraw it."

The gist of the representations above quoted made for the purpose of distinguishing the invention of the patent in suit from the prior art as cited by the Patent Office appears to be that in the patented process, heat is not used for the purpose of softening the blank, does not in fact soften the blank, but that heat is used

405 solely for the purpose of expanding the blank against the matrix, thereby imprinting the configuration of the matrix on the blank. Are these statements of the operation involved in the patent in suit in accordance with the operation involved in your experiment in which you made "Complainants' Exhibit, Browne-Edison Celluloid Record"?

A. The Edison patent in suit describes several embodiments of the invention. He contemplates that in
406 some instances and with some materials heat alone may be sufficient to mold the record; that with other materials the entire expansion may be effected mechanically (page 2, line 55); and that in still other intances, both heat and mechanical pressure may be employed. The various claims of the patent are couched in such language that these different modes of procedure are defined.

The same is true in the Edison application at the time the several statements were made which you have
407 quoted. For example, on September 2, 1898, as the result of the amendment then filed and dated September 1, 1898, the application contained ten claims, four of which (namely, 3, 4, 7 and 10, as then numbered) contained no reference to heat as the expanding factor; whereas five of the other six claims then in the case did specify heat as an expanding factor; and the tenth claim then in the case (then numbered 8) mentioned heat without reference to any molding factor due thereto, but referred to the expansion of the blank as
408 the result of mechanical means.

The various arguments and the statements which you have quoted were thus applicable only to the five claims which included heat expansion, and were not pertinent to the other five claims.

This is evidently the view taken by the Examiner, because in the succeeding official letter of September 15, 1898, he allowed the five claims to which the arguments and statements applied, but he again rejected claims 3, 4, 7, 8 and 10, to which they did not apply.

409 Accordingly, these quoted statements are not "of *the* operation involved in the patent in suit", but are simply statements of one of the several operations involved in the patent in suit. In the experiment in which "Complainants' Exhibit Brown-Edison Celluloid Record" was made, one of the procedures set forth in the Edison patent in suit was followed, but not the specific procedure defined in claims 1, 2, 5, 6 and 9, as they were numbered on September 2, 1898, and to which the quoted arguments and statements 410 were alone directed.

x-Q. 20. In your reply to Q. 2, you state that the process disclosed in Edison patent 484,582 is "wholly impracticable," because of the sawing of the mold into sections. Do you base this statement upon the fact that the removal of metal by a saw would necessarily destroy part of the record, and do you consider this defect apparent upon a mere reading of the patent ?

A. Yes.

411 x-Q. 21. In certain of the claims in suit there is included the step of depositing a metal vapor upon the original phonogram in a vacuum. Can you state whether this step is not fully described in Edison patent No. 526,547 ?

A. Yes, it is so stated in the patent in suit at lines 54 to 57, page 1, except that there is a clerical error in the number.

x-Q. 22. This process is also substantially disclosed, is it not, that is the deposition of metal in a vacuum, in Edison patent No. 484,582 ? 412

A. Yes.

x-Q. 23. In lines 46 to 51, page 2 of the specification of Edison patent 484,582, reference is made to another application filed by the patentee on January 5, 1898, Serial Number 259,895. Do you know whether this application ever matured into a patent ?

A. No. I know nothing whatever about it, one way or the other.

x-Q. 24. In view of your statement that the sawing apart of the matrix as described in Edison patent

413 484,582, is wholly impracticable and that its defective character would be apparent upon the mere reading of the patent, and in view of the further fact that the claims of Edison patent 484,582 omit all reference to the sawing apart of the matrix and are confined to the deposition of metal in vacuo, I would like to know whether you can state any reason or justification for the description of the impracticable operation of sawing the matrix apart being inserted in this patent?

414 A. It is necessary for the patentee to describe some way of getting duplicate phonograms out of the mold, as otherwise he could not get a useable record, and in two of his claims (2 and 3) "removing the original phonogram" is a specified step. Accordingly, it was necessary for him to describe some means of effecting the removal and also the best means which he then knew about. Accordingly, he did describe his means for removing the records and he undoubtedly described the sawing of the mold into sections as being the only
415 way that he knew of to permit the removal of the records.

x-Q. 25. At the head of the specification of the Edison patent 484,582, the following notation appears:

"Renewed March 30, 1892."

Can you explain the significance of this notation?

A. It means that the case was allowed and that more than six months had elapsed and that during this time
416 the Government fee of $20 was not paid. After the lapse of this period of six months the applicant paid a renewal fee of $15. This reinstated the application and then on a second allowance and the payment of the $20 fee the patent issued.

x-Q. 26. You have stated that you do not know what the co-efficient of expansion of celluloid of the composition used in phonograph records is. Have you such approximate knowledge of this co-efficient as to enable you to state whether it would cause the diameter of "Defendants' Exhibit, Defendants'

417 Finished Blank" to increase $\frac{1}{32}$ of an inch upon the application of the degree of heat of saturated steam at 40 pounds pressure?

A. No.

x-Q. 27. If the tube *a* as described in the Appelt patent 303,970 bore upon its inner surface a phonographic record, is it your opinion that the roller which is cast in the mold could be removed therefrom by following Appelt's process?

418 A. I have not the slightest idea. Appelt melts his compound of gelatine, glycerin and other more secondary ingredients and pours it into his mold. I do not know whether or not such compound would stick on a regular matrix surface or it would shrink sufficiently on cooling to clear the matrix.

x-Q. 28. Upon direct examination you have stated that in the process of the Lioret patent, "the radial contraction of the duplicates is not sufficient to clear them from the interior surface of the mold." How are you enabled to state this as a matter of fact? 419

A. Because Lioret says that he has to unscrew the duplicates. Then, as a matter of inevitable inference the longitudinal contraction would necessarily result in the screw threads of the record hugging more closely than ever the screw threads of the mold.

x-Q. 29. You did not mean to convey the idea in the passage quoted in the last question that the radial contraction of the Lioret duplicate is not sufficient to clear the phonographic indentations of the record from the indentations of the mold, did you? 420

A. No, as to that, I did not.

x-Q. 30. Lioret describes the screw thread of his matrix as being triangular in cross-section. Would not radial contraction of the duplicate record result in longitudinal clearance at the sides of the screw thread, and thus permit longitudinal contraction of the duplicate record without causing any binding between the duplicate record and the matrix?

A. No.

x-Q. 31. Please explain your reply?

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A. Because the angle at which the screw-thread walls diverge remains constant, and consequently radial contraction would not prevent the squeezing of the metal threads by the contracting celluloid threads.

x-Q. 32. Is it not simply a question of the degree of acuteness of the angle of the screw thread in cross-section, which determines whether or not the radial contraction of the duplicate record would produce sufficient longitudinal clearance between the screw 422 threads of the duplicate record and matrix to prevent binding?

A. Yes.

x-Q. 33. And if the cross-sectional angle of the screw thread were sufficiently obtuse, there would be no binding between the duplicate record and matrix when the matrix contracted, would there?

A. Possibly not, but nothing of the sort is suggested in the Lioret patent. On the contrary, his scheme is directly opposed to any such obtuse angle threads and 423 he shows acute angle threads because he wishes to reduce to a minimum the labor required to cut the indentations in the threads by his recording style. Hence, an acute angle is an essential.

x-Q. 34. With an obtuse angle thread, the recording stylus would have to cut less than when operating upon a smooth surface, would it not?

A. Yes.

x-Q. 35. A further advantage which Lioret mentions as desirable in cutting the record at the apex of the 424 screw thread, is that it obviates side friction upon the cutting stylus. He would secure this advantage regardless of whether the angles were acute or obtuse, would he not?

A. No. It would depend entirely upon the shape of his stylus, and its breadth with respect to the depth of the cut.

x-Q. 36. The fact that Lioret refers in his patent to the absence of lateral frictional contact, due to surfaces adjacent to the cutting stylus, it would follow, would it not, that the breadth of his stylus was so

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proportioned to the angle of the thread, whatever that angle might be, that the sides of the stylus were at all times free from contact with the cut formed?

A. No. It simply follows that the illustrated screw threads are sufficiently deep so that the style may cut the necessary depth without its side edges coming in contact with contiguous surfaces.

x-Q. 37. In your direct testimony you criticise Lioret's process upon the theory that water would be trapped in the spiral space between the celluloid ring and 426 the mold, and you criticize Mr. Carter's remedy, which he states would be obvious, upon the ground that air would be trapped. Do you find anything in the Edison patent in suit to remedy the alleged defect to which you refer?

A. It is a thing which does not exist in the Edison method because of the character of the matrix, and the mode of operation described.

x-Q. 38. What is it about the character of the matrix of the Edison patent in suit which renders this alleged 427 difficulty non-existent?

A. The gradual inclination of the side walls of the indentations which do not form pockets for the air to get into and stay. The matrix is also open at both ends during the molding operation and is not sealed as Mr. Carter's remedy contemplates.

x-Q. 39. Did you ever attempt to make a duplicate celluloid record from a blank similar to "Defendants' Exhibit, Defendants' Finished Blank," and proceeding according to the steps followed by you making "Com- 428 plainants' Exhibit, Browne-Edison Celluloid Record"?

A. No, because the specific tapering mandrel described by Edison is to be used for expanding the blank, and hence the interior bore of the blank must be tapered which is, I understand, not true of "Defendants' Exhibit, Defendants' Finished Blank." To expand a blank having a cylindrical bore, some substitute expander must be used instead of the tapering mandrel which Edison shows and describes.

x-Q. 40. In your comparison of the process of the

429 British patent to Young and the process of the patent in suit, you make the distinction that Young's blank is very thin, while the blank of the patent in suit is "of sufficient thickness to maintain its shape during and after its engagement with the matrix." I think you have explained quite fully why in your opinion Young uses a thin blank, but I think you have not stated what function results from the thickness of the blank used in the process of the patent in suit. Will you 430 please do so?

A. This thickness is sufficient to enable the blank and the resultant record to be handled until it is put into condition to be used on the phonograph without becoming distorted. Also, this gives sufficient body to a blank to enable it to shrink sufficiently to clear the matrix to enable direct withdrawal therefrom.

x-Q. 41. What has the thickness of the blank to do with its contraction from the matrix?

A. A great deal. It may be so thin and pliable that 431 it has to be collapsed in order to get it out.

x-Q. 42. Did you ever see a blank so thin that it had to be collapsed in order to withdraw it from the matrix?

A. I am not entirely sure. I was in a patent suit a number of years ago in which the phonographic records were so thin that they had to be collapsed in order to get them out of the mold and I do not now recall whether any of them were produced in evidence at that time or not. I understand that a great many 432 were made. The patent I refer to was a patent to Capps, No. 666,493, Jan. 22, 1901, which says:

> "I separate the celluloid record from the matrix by bending the celluloid record inwardly away from the matrix at different points and then partially collapsing the record to allow it to be withdrawn from the matrix. This bending and collapsing of the celluloid record within the matrix does not injure the record, because of its elastic nature." (Page 2, lines 101–109).

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x-Q. 43. In the process of the Capps patent no blank at all is used, is there? Is not the record simply formed by depositing some substance from a solution upon the matrix and then separating it therefrom?

A. Yes. Capps introduces his record-making material within the mold in a fluid condition and it hardens or dries. Accordingly, there is nothing which can properly be called a blank. What Capps collapses
is a finished celluloid record, in which respect it re- 434
sembles the Young British patent, wherein the collapsing is of the record and not of the blank.

x-Q. 44. Your testimony seems to indicate that you wish to convey the idea that there is some connection between the thinness of a blank and the extent or manner of its contraction upon cooling. If I am correct in this, will you please state what connection there is between these things?

A. I have stated it as fully as I know how.

x-Q. 45. It is your opinion, is it, that the blank 435
which is used in the process of the Young patent would by reason of its thinness fail to contract upon cooling sufficiently to separate itself from the matrix without being forcibly distorted by the operator carrying out the process?

A. Yes.

x-Q. 46. Do you know whether the co-efficient of expansion of solid bodies is in any way related to the shape or size in which masses of such bodies occur?

A. No. 436

x-Q. 47. You have stated in effect in your direct testimony that Young's blank is in the form of a very thin hollow cylinder and that accordingly he could not have used a tapered mandrel to expand it. Do you think a tapered mandrel could be used with "Defendants' Exhibit Defendants' Finished Blank"; that is, with a blank of that thickness?

A. As I understand it, this blank has a cylindrical interior and accordingly a tapering mandrel could not be used.

437 x-Q. 48. Is this blank formed of material thick enough so that it could be used with a tapered mandrel?

A. I am unable to measure the thickness of the blank with any facilities I have at hand and accordingly cannot express an opinion.

x-Q. 49. Referring to Defendants' Exhibits, entitled respectively "Young Patent Records Nos. 1 to 8 inclusive," will you state whether the material of these 438 records is sufficiently thick to permit their being tapered inside for use with a tapered mandrel?

A. I do not know. I should consider it improbable but would like to see it tried before reaching a definite conclusion.

x-Q. 50. Do the words "radial contraction" occurring in claim 2 of the patent in suit refer to the contraction of the phonogram after the previous expansion of the blank by heat?

A. Yes.

439 x-Q. 51. Claim 4 refers to "disengaging the impressed record cylinder from the matrix." Does this expression refer to contraction due to cooling?

A. Yes.

x-Q. 52. Claim 9 refers to "expanding the blank into intimate engagement with the record," and to "removing the cylinder by direct longitudinal movement." The step of contracting the phonogram radially is not mentioned. Is it your opinion that this step is included by implication in the passages above quoted 440 and that the contraction must be taken as due to cooling?

A. Undoubtedly the claim contemplates some way of disengaging the record from the matrix, but does not specify, wishing to leave the claim of sufficient scope to include any way which may prove to be the equivalent of the specific contraction described. Accordingly, I do not understand that the claim is limited to disengagement by shrinkage due to cooling.

x-Q. 53. Does the specification of the patent refer to

441 any other means than cooling for effecting the radial contraction of the phonogram?

A. No.

x-Q. 54. Does the method of constructing the matrix in any way modify the subsequent step of forming a phonogram on the matrix.

A. Yes. If a matrix is made in a particular way, it may necessitate forming a record therein in one specific way and exclude all other ways?

442 x-Q. 55. Would there be any such distinction involved in making the matrix by the electro-plating process and by the process of depositing metal in vacuo on the original or master record?

A. Yes.

x-Q. 56. In what way would the process of making duplicate phonograms from a matrix constructed by electro-plating be different from the process of making phonograms from a matrix made by depositing metal in vacuo on the original or master record?

443 A. I do not know how it would be possible to make a matrix by depositing metal in a vacuum on a master record and using it for making duplicates.

x-Q. 57. In my previous question I referred to the electro-plating process upon the matrix as described in the British patent to Young, regarding which you have testified and to the process of depositing metal in vacuo as described in Edison patent 526,147, and Edison patent 484,582. With this additional information, will you please answer the preceding question?

444 A. The vacuous deposit process described in these two patents does not produce a matrix. It merely applies an exceedingly tenuous film of metal on the master record for the purpose of making the surface electro conductive. A matrix is then made by an electro deposition upon this coated master record; and it is this resulting matrix made by electro-deposition which is used in making the duplicates.

The only difference in using such a matrix and using a matrix made in accordance with the Young patent

445 would be the increased fidelity of the record to the original sound.

x-Q. 58. The steps which the operator performed in making duplicate phonograms from the two kinds of matrices would be identically the same, would they not?

A. Not if he practiced the processes of the Young patent and of the Edison patent in suit respectively.

x-Q. 59. Whatever process was used its application
446 would not be affected in any way, would it, by the fact that either one or the other of the two kinds of matrices were selected?

A. The subsequent steps of the process could be the same, whichever matrix were used, the only difference would be the resulting products.

x-Q. 60, Referring to claim 10 of the patent in suit, are any means described in the specification of the patent other than contracting by cooling for "shrinking the blank to disengage it from the matrix"?

447 A. No.

x-Q. 61. Referring to claim 13, does the specification of the patent in suit describe any means other than contraction by cooling for rendering it possible to remove the cylinder by direct longitudinal movement?

A. No.

x-Q. 62. Referring to claims 16 and 17, is there any means described in the patent specification, for rendering it possible to remove the cylinder by direct longitudinal movement other than the previous shrinking
448 of the cylinder cooling?

A. No.

x-Q. 63. I notice that claim 17 refers to a cylinder or tube of softened material. What agency does the specification set forth for effecting the softening of the material?

A. Heat, provided that the substance of the blank is not in the first instance sufficiently soft to avoid special heating as is suggested may be the case at lines 53–56, page 2.

x-Q. 64. Does the specification of the patent dis-

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close any other agency than heat for softening the blank phonogram?

A. No.

x-Q. 65. Your statement that heat acts as a softening agent does not accord with the patentee's own idea, does it, as expressed in the quotations from the papers filed in the Patent Office during the prosecution of the application of the patent in suit, such quotations appearing in x-Q. 19 and in the certified copy of decisions, filed as an exhibit herein? 450

A. Certainly. In the quotations which are contained in x-Q. 19, the applicant was endeavoring to distinguish his specific claims from Young and Lioret, which claims were directed solely to the specific process wherein heat alone was used to get the impression and in which any softening due to the heat might be a negligible factor. In the affidavit of Mr. Wurth, from which a quotation was made, I do not notice that he describes the blank material which he was then using; and, accordingly, I 451 cannot express any opinion as to the substantial character of any softening which might exist at the temperature of 115 degrees, which Mr. Wurth mentions.

But, so far as I am acquainted with any materials which are utilized in a molding process where heat and pressure are employed, softening is inseparable from heating. I do not find anything in the papers from which you have made quotations which is inconsistent with an appreciation on the part of Mr. Edison 452 that the softening due to heat was a recognizable factor in using material where pressure from a mechanical source was employed in addition to heating.

Adjourned to Friday August 12, at 10.15 a. m.

453

ORANGE, N. J., August 12, 1910.

Met pursuant to adjournment.

Present : Counsel as before.

THE CROSS-EXAMINATION OF THE WITNESS IS CONTINUED BY MR. SCOTT :

x-Q. 66. Have you any means of making any state-
454 ment as to whether the records introduced in evidence
as Defendants' Exhibits, Young Patent Records, Nos.
1 to 8 inclusive, are as thin as those described by
Young in his English patent ?

A. Nothing beyond Mr. Carter's description of the
way these records were made, which shows that they
did not act as Young describes. Moreover, Young not
only asserts that heating his blanks makes them
plastic, but it also makes them pliable ; and in my
judgment the material of which these exhibits is
455 made would not when heated be pliable to any ex-
tent that would be useful. In this connection I
might say that in the early phonograph art it was
customary to use a pliable material in making sound
records, tin-foil being described in the original
phonograph patent of Edison No. 200,521, Feb.
19, 1878. Tin-foil was used because it was so
pliable that it could bend to any configuration it was
desired. I understand, therefore, that Young intended
to have his celluloid so thin that it would have plia-
456 bility comparable to that of tin-foil, so that the result-
ing impression taken from the mold would be due
to the bending of the celluloid to fit the irregularities
of the mold as well as to the plasticity of the heated
celluloid. That is to say, both the plastic and pliable
qualities of the thin celluloid were to be utilized. In
my judgment, the celluloid of the exhibits mentioned
is too thick to be pliable when heated within the mean-
ing of the Young patent.

x-Q. 67. Do you find anything stated in the Young patent upon the subject of having the celluloid so thin

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that it would conform to the sound record and matrix by bending?

A. Nothing beyond the fact that he states that the celluloid is *very thin* and is rendered *plastic* and *pliable* by heat so that he can press the blank "gently and evenly up to and against the face of the electro", this being taken in connection with known and common employment in the early art of materials utilized for their pliability, so that they may by bending take the desired configuration. 458

x-Q. 68. You have testified to the effect that Young discloses no means for pressing his blanks outwardly against the matrix; that Defendant's Exhibits, Young Patent Records, Nos. 1 to 8 respectively, are probably too thin to be tapered interially for use with the expanding mandrel described in the Edison patent in suit; and that the records contemplated by Young in his patent were probably thinner than Defendants' Exhibits, Young Patent Records Nos. 1 to 8. In view of these facts does the Edison patent in suit 459 teach anything that Young's did not teach in the way of means for expanding celluloid records of the character described by Young in his patent or of the character used by Mr. Carter in making Defendants' Exhibits, Young Patent Records Nos. 1 to 8?

A. Young's patent does not teach anything concerning means to expand, and at the time his application was filed I know of no means known in the art which could be used for pressing outwardly the blank beyond some hand-operated tool. The Young patent is deficient in this respect. 460

The Edison patent, however, discloses competent expanding means and hence presents an adequate disclosure of the process.

Also, at the time of the Edison patent a pneumatically expanding mandrel was known in the art, being set forth in the complete British specification of Lioret, filed September 5, 1894, and accepted October 13, 1894, on which latter date it was accessible to the public. Hence, at the date of Edison's application

461 fluid expansion was the known mechanical equivalent of a tapering mandrel.

Accordingly, the Edison patent teaches much more than the Young patent.

x-Q. 69. In my preceding question I enquired whether the Edison patent in suit taught anything that Young's did not teach in the way of means for expanding celluloid records of the character described by Young in his patent or of the character used by Mr.
462 Carter in making the exhibits referred to. In your reply you have referred to no additional teaching except that set forth in the Lioret patent. Do you mean by this answer to convey the idea that there is no additional teaching in the Edison patent in suit on this subject and that Young and Lioret were the only contributors of any information regarding the expansion of celluloid records of the character referred to in x-Q. 68?

A. No. Young does not contribute any information
463 at all.

x-Q. 70. Does Edison in the patent in suit contribute anything applicable to celluloid records of the character described in x-Q. 68?

A. The Edison patent does not describe how celluloid records of the character of "Defendants' Exhibit, Young patent Records, Nos. 1 to 8", could be expanded. He does describe a complete process, including competent expanding means; and at the date of his application equivalent expanding means were known
464 in the art competent to expand records of the character of these exhibits.

x-Q. 71. These equivalent means to which you refer were invented by Lioret and not by Edison, were they not?

A. Yes.

x-Q. 72. Do you know whether celluloid records were ever made commercially by the process used by you in making the "Complainant's Exhibit, Browne-Edison Celluloid Record"?

A. No.

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x-Q. 73. Did you yourself prepare the celluloid blank used in making "Complainants' Exhibit, Browne-Edison Celluloid Record"?

A. No.

x-Q. 74. Do you know how it was made?

A. No.

x-Q. 75. Do you know where it was secured?

A. No.

x-Q. 76. From an inspection of it can you form any
idea as to how it was made? 466

A. No.

x-Q. 77. Can you state the approximate cost of the material and labor involved in making the blank used by you in constructing "Complainants' Exhibit, Browne-Edison Celluloid Record"?

A. No.

x-Q. 78. So far as you know then, I take it that the
total cost of a record like "Complainants' Exhibit,
Browne-Edison Celluloid Record", including the cost
of labor and material in the blank, might be a hun- 467
dred times the price for which commercial records are
sold?

A. I know enough about the subject to know that
that would not be the case. I have heretofore been
retained in patent litigation by the Celluloid Company
and have visited their factory in Newark, N. J. and
made numerous tests therein; and I am quite confident
that if an order were given to the Celluloid Company,
specifying blanks such as used in making "Complain-
ants' Exhibit, Browne-Edison Celluloid Record", they 468
would supply them for a price very much less than
that indicated in the question.

x-Q. 79. Can you state how the blanks from which "Complainants' Exhibit, Browne-Edison Celluloid Record" was provided with its tapering bore in which the mandrel fitted?

A. No.

x-Q. 80. You have testified that so far as you know it would be impossible to make a record from "Defendants' Exhibit, Defendants' Finished Blank" with-

469 out first softening the blank. Mr. Charles Wurth in his affidavit filed in the Patent Office in support of the amendment dated September 1, 1898, to the application for the patent in suit, says that it would be possible to obtain a duplicate celluloid record as described in the Young patent, but that it would not be possible to remove the duplicate after it was obtained, since the heating of the blank to the point of plasticity would inevitably cause it to stick to the mold and thereby in-
470 jure the record in whole or in part. Mr. Edison, in his affidavit, in support of the same amendment, said that Mr. Wurth's statements were true. In an argument dated September 7, 1899, filed in the Patent Office as a part of the proceedings in the application for the patent in suit, the following statement is made with reference to the Young and Lioret patents:

> "Not only are both of the references capable
> 471 of this legitimate criticism, but it is to be noted that they do not meet the terms of the rejected claims, since with both references the blanks are heated to the point of plasticity, and the engagement with the mold is effected by actually displacing the material of which the blank is formed. This is not the equivalent of applicant's step of expanding the blank into engagement with the mold, the blank being heated below the point of plasticity necessarily, because
> 472 otherwise it would stick to the mold and would destroy the record if an attempt were made to withdraw it."

Do not the passages just referred to in the application papers on which the patent in suit was granted indicate that Mr. Edison thought it impossible to make records of celluloid, inasmuch as, according to your statement, the celluloid would have to be softened and according to his statement, if the celluloid was soft-

473

ened, it would stick to the mold or matrix and destroy the record when an attempt was made to withdraw it?

A. No.

x-Q. 81. Is there anything in the Edison patent that teaches how records could be made of celluloid without first softening the celluloid?

A. No.

x-Q. 82. Is there anything in the Edison patent in suit that teaches how if the celluloid were softened, it
could be prevented from sticking into the mold or 474
matrix and being destroyed when it was withdrawn therefrom?

A. Yes.

x-Q. 83. What is it?

A. The patent states that the blank should be put within the matrix and the mandrel should then be inserted in the blank and the whole then be heated. with reference to the temperature the specification says

475

> "The degree of heat necessary to properly expand the blank will depend largely upon the material of which the blank is formed and upon the closeness of fit of the blank when inserted within the matrix or mold" (Page 2, lines 84–88).

Claim 18 also refers to softening the celluloid tablet.

Accordingly, the heat must be sufficient to enable
the molding to be done and not sufficient to cause 476
the celluloid to stick to the mold. It was unnecessary to state the number of degrees in Fahrenheit because the manipulation of celluloid under heat was then a matter of common knowledge.

x-Q. 84. If this was a matter of common knowledge, will you state what degree of heat or what manipulation would be necessary?

A. Celluloid becomes sufficiently soft at a temperature of boiling water to enable it to be very readily

477 molded; and for many purposes this is the way the celluloid is treated. As the heat is increased the celluloid gets into a pasty condition. Indeed, in many of the steps in treating celluloid the pasty characteristic is so marked that it flows like thick molasses.

Celluloid is brought to this condition, for example, when different colors of celluloid are incorporated together, as in making imitation ivory and onyx. I have known the exact temperature at which this occurs
478 but I cannot carry the figures in my head. At this temperature there is no danger of the celluloid adhering to a metal surface. The celluloid need not be brought to this flowing pasty condition to enable it to be molded. Probably, some temperature in excess of 212° Fah. and below the readily ascertainable temperature at which the celluloid flows, a proper temperature would be reached. The only manipulation then required would be to expand the celluloid blank in the manner described in the Edison patent, or by an equiv-
479 alent means as by the pneumatic expander of Lioret.

x-Q. 85. The gist of your answer seems to be that you think that the celluloid can be prevented from sticking to the mold or matrix by heating to a certain temperature, that temperature being sufficient to soften it so that it can be molded, but not high enough to soften it to the extent of causing it to become sticky or adhesive. Will you please state whether the patent in suit contains any information regarding just what this particular temperature is, that is, any information
480 over and above what is conveyed by the Young and Lioret patents?

A. You do not understand my testimony correctly. I do not consider a specific temperature necessary. There might be quite a range. It would be sufficient to use any of the moldable temperatures which are employed, so long as the temperature is not carried to an excessive degree.

As to the temperature of the celluloid the Edison patent contains no more information than do the Young and Lioret patents. Prior to both Young and

481 Lioret, the molding temperatures of celluloid were well known and readily accessible to any investigator.

x-Q. 86. If these matters were well known and readily accessible to any one, how did it happen that so eminent a scientist as Mr. Edison and his assistant Mr. Wurth, labored under the impression and represented to the Patent Office that the process of the Young patent would be inoperative by reason of the fact that the celluloid when softened by heat would stick to the matrix or mold, thus resulting in the de- 482 struction of the record when it was withdrawn therefrom?

A. Neither Wurth nor Edison make any such statement. The nearest thing which Wurth says is that "the heating of the blank to the point of plasticity would inevitably cause it to stick to the mold and thereby injure the record in whole or part" (in criticising the Young patent), from which I infer that Mr. Wurth did not adequately understand what is meant by "plasticity," apparently thinking that it involved 483 such a high temperature as would cause sticking. This is very far from a foundation for the assertion that neither Mr. Edison nor Mr. Wurth knew that merely softening celluloid by heat would not cause it to stick to the mold.

x-Q. 87. You are of the opinion, are you, that Mr. Wurth, and Mr. Edison, who confirmed his statements, thought that heating celluloid to the point where it became plastic involved such a high temperature as would cause sticking? 484

A. Yes, they evidently misunderstood the word "plastic" as used in the Young specification. In this respect the allegations were erroneous and the argument based upon them was unsuccessful. The Examiner's response of October 14, 1899, again rejected the claims, which did not then contain the limitation of expansion due solely to heat upon the Young patent and asserted his belief in the operativeness of the Young process. The applicant was in error as to what

485 Young meant as to "plastic" and the argument based upon the error was unsuccessful.

x-Q. 87. I quote the following passage from the amendment dated September 1, 1898, to the application for the patent in suit, and ask you to explain the distinction involved in the use of the words "displaced" and "expanded":

> "The claims which have been erased are canceled in view of the fact that they appear to cover processes which are broader than applicant's invention, namely, processes wherein the blank in the process of duplication is displaced instead of being expanded."

486

A. I understand by "displaced" that the writer of the argument from which the quotation is made intended to mean such displacement as is involved in distorting or bending the material as distinguished from expansion along radial lines. 487

x-Q. 88. Referring again to the Capps patent No. 666,493, is there any question of expanding or contracting the phonogram or blank from which it is made, in operating under the process of this patent?

A. There is nothing in this patent about expansion. There is about contraction. The specification says that there can be added to the celluloid solution "a proper quantity of a suitable material to cause the solution to contract in drying, so as to cause the film to be separated from the matrix and facilitate its removal" (page 2, lines 77–81). 488

Also, Capps describes a mixture of beeswax and rosin if rendered fluid by heat and which is cast in the matrix and concerning this, the patent says:

> "The beeswax and rosin record is allowed to dry and harden, and in drying it contracts and separates from the film-matrix and can readily be removed" (page 2, last line).

489

x-Q. 89. The contraction you have referred to is not due to cooling, is it?

A. It is in the case of the beeswax and rosin record.

x-Q. 90. Do you find anything in the Young British patent to indicate that he causes the celluloid blank to conform to the sound record in the matrix by bending the celluloid, as distinguished from doing so by indenting the surface of the blank?

A. Yes. He says that he renders the celluloid pliable and hence in condition for bending. Then he 490 applies pressure "gently" and only gentle pressure would be required in order to bend the pliable material. I understand, therefore, Young conforms his blank to the matrix by reason of its pliability, as well as by its plasticity.

I note, in this connection that Mr. Carter in referring to the making of some of the Defendants' exhibits, purporting to be made in accordance with the Young patent, states that the blanks were "subjected to the pressure of about 80 pounds per square inch," this 491 being used to get the indentations. On the contrary, Young only applied a gentle pressure, such as would be competent to utilize the pliability of the thin celluloid in bending it into conformation with the matrix.

x-Q. 91. Young refers to the use of celluloid or some other material capable of being made plastic by heat. Under pressure, plastic material will be indented if applied to a roughened surface, such as the sound record of a matrix, would it not?

A. Yes, if sufficient pressure were employed. This 492 is shown by Mr. Carter's tests wherein a pressure of 80 pounds per square inch is employed.

Cross-examination closed and no re-direct.

Arthur S. Browne.

493

CIRCUIT COURT OF THE UNITED STATES,

NORTHERN DISTRICT OF NEW YORK.

NEW JERSEY PATENT COMPANY and NATIONAL PHONOGRAPH COMPANY, Complainants, 494 vs. GEORGE C. SNOWDEN, JAMES H. SNOWDEN and HENRY MCSWEENEY, doing business as a co-partnership under the name and style of the Indestructible Phonographic Record Company, Defendants. 495	In Equity No. 7240. Letters Patent 713,209.

Stipulation.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the annexed copy of the deposition of Mr. Frank L. Dyer, with accompanying exhibits, taken in the suit of National Phonograph Company vs. Lambert Company, 496 In Equity No. 26,598, under Patent 713,209, may be offered and received herein with the same force and effect as though taken on behalf of complainants in this suit.

Chicago, June 11, 1910.

MELVILLE CHURCH,
Counsel for Complainants.
WALTER A. SCOTT,
Counsel for Defendants.

497

UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF ILLINOIS, NORTHERN DIVISION.

NATIONAL PHONOGRAPH COMPANY,
vs.
LAMBERT COMPANY.

In Equity.
No. 26,598 on
Patent No.
713,209. 498

Rebuttal testimony on behalf of complainant taken pursuant to notice before John F. Randolph, Esq., a Notary Public and Special Examiner by consent at the Edison Laboratory, West Orange, New Jersey, May 3, 1904.

Present—RICHARD N. DYER, ESQ., for Complainant. 499

Frank L. Dyer.

FRANK L. DYER, being duly sworn, testifies as follows:

DIRECT EXAMINATION:

12 Q. You have already given a deposition for complainant in this case?

A. I have. 500

13 Q. Have you read the deposition of defendant's expert, Henry W. Carter?

A. I have.

14 Q. What in your opinion is the relation of the invention of the patent in suit to the present art of duplicating phonograph records by means of molds carrying the record in relief on their bore?

A. The patent in suit stands at the foundation of the modern art of duplicating phonograph records. That art not only found its incep-

501

tion in Mr. Edison, but it was developed and first actually used commercially by him. In one of his earliest British patents relating to the phonograph, No. 1644 of April 24, 1878, he suggests the possibility of securing duplicate copies of an original phonograph record by three distinct methods: *first*, by a mechanical transference, wherein a reproducer engaging with the original record is connected with a recorder which forms a copy on an adjacent blank; *second*, by a knurl-
502 ing operation, wherein a knurl corresponding to the original sound record impresses its formation on a rotating blank or moving strip; and *third*, by a casting process, wherein a plastic material like plaster of Paris is cast in a split mold having the record formed in negative on its bore. In his first United States patent on the phonograph, No. 200521 dated February 19, 1878, he had previously referred to this possibility as follows:

503

> "The record, if it be upon tinfoil, may be stereotyped by means of the plaster of Paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tinfoil or other material upon it. This is valuable when musical compositions are required upon numerous machines."

When Mr. Edison took up the work of commercially perfecting the phonograph in 1887, the possibility of
504 making duplicate copies of phonograph records evidently again presented itself to his attention. At this time the records were no longer in the form of a metal foil temporarily applied to the threaded mandrel, but were cylindrical tablets having a coating of a waxlike composition in which the record was cut by means of a cutting recording tool connected directly with the diaphragm. In his early work in thus commercially perfecting the phonograph, some time appears to have been devoted to the development of the original blank or recording surface, and the present modern all-wax

505
blank with a tapered bore was invented and patented
by him (Nos. 382418 and 382462 dated May 8, 1888).
About this time the modern standard dimensions of
blank and pitch of thread were adopted by Mr. Edison,
and for the past 15 years all standard talking
machine records have been approximately $2\frac{1}{8}$ inches in
external diameter, $4\frac{1}{2}$ inches in length, and with a pitch
of feed screw of 100 per inch, giving a corresponding
pitch to the record groove. These standards are now
absolutely fixed, since several million talking machines 506
are now in use in this country, and many million
phonograph records for use therewith are manufactured
annually. With the original Edison phonograph
of 1878 the pitch of the record groove was about 20
threads per inch, so that the available surface in which
the record could be formed was $\frac{1}{20}$ of an inch. The
adaption of the present modern standards by Mr. Edison
resulted in a contraction of the available space in
which the record groove could be formed to .01 of an
inch or only $\frac{1}{5}$ the width of that available with the 507
original tinfoil machine. Of course this necessarily
made the problem of successfully duplicating phonograph
records enormously more difficult. The difficulty
of the problem which Mr. Edison encountered in 1887
will be appreciated when it will be remembered that
the surface of the phonograph record which he sought
to duplicate was composed of millions of distinct but
excessively minute indentations, the *maximum* width
of which was only .01 of an inch, and each of which
was of a characteristic form which had to be faithfully 508
copied in order to secure an accurate reproduction of
the sounds.

In order that a successful duplicating process
could be carried on, it was first necessary to construct
a matrix or mold carrying an accurate
negative representation of the original record,
and on January 5, 1888, Mr. Edison filed an application
for a patent which issued on October 18, 1892, No.
484582, in which patent he fully describes several
schemes for making matrices or molds, including the

509 so-called vacuous deposit process now utilized by complainant, as well as the graphite process which defendant employs. At this early date in the art, although Mr. Edison had apparently fully perfected the process for making an exact matrix or mold, he had not perfected the process by which duplicate phonograph records could be obtained from such a matrix or mold, and in the patent referred to he describes the expedient of splitting the matrix or mold longitudinally so
510 as to form a sectional mold in which duplicates could be cast as in an ordinary casting operation and from which the resulting articles could be removed by opening the mold sections after the molded material had set. It is evident from a consideration of the claims of this split mold patent (the application for which was filed on January 5, 1888) that it was taken out primarily to cover the special process followed in making a matrix or mold by vacuous deposit, because the claims are all limited to this feature. That patent
511 did not cover a commercially operative process of obtaining the duplicates from the matrix or mold, for the reason that the expedient of splitting the mold would result in the production of minute burs or fins on the duplicates which would seriously interfere with the reproduction, and also because the casting process suggested therein would inevitably result in an imperfect surface marred with air bubbles, since at the instant the molten material engaged the mold surface it would be in a condition of agitation and aeration.
512 It is evident now that a split mold could not be successfully used from which to obtain duplicate phonograph records, but up to January 1888 Mr. Edison had not made the discovery that a duplicate record could be removed from a continuous mold without injury to the recording surface. In fact, the discovery could not have been made, since the character of the records of that date was such that they could not be satisfactorily removed from a continuous mold. In other words, in January 1888, phonograph records were made by means of a chisellike recording

513 tool forming a flat bottomed record groove of the same width throughout but of varying depth and with substantially vertical walls. Consequently in casting a record of this kind in a mold, it was necessary that the record should be gotten out before contraction had taken place, because any relative longitudinal movement of the record with respect to the mold would result in injury to the surface. Of course by using a split mold, the record could be removed by opening the mold sections immediately after the material had 514 set and before any longitudinal contraction had taken place.

Recognizing, apparently, the difficulties attendant upon the use of a split mold, and especially the condition of agitation and æration of the material at the moment of setting, and the danger of injury to the record by a longitudinal contraction before the mold was opened to release the duplicate, Mr. Edison appears to have turned to the possibility of duplicating records by a knurling process, as he had generally suggested 515 in his British patent of 1878 before referred to. Therefore on March 8, 1888, he filed an application for a patent on a knurling process which issued on May 8, 1888, No. 382,419, and in which the British patent is specifically mentioned. This knurling suggestion does not differ materially from the suggestion of the British patent except as to the refinement of the details by which a very perfect knurling surface is secured. By a knurling operation an impression would be formed in a perfectly quiescent material and no considerations of 516 longitudinal contraction would be encountered, so that the special variety of records in vogue at that date could no doubt be duplicated. But the knurling process described was open to one of the objections of the split mold process, because in producing the knurl the latter required to be divided, and hence the surface of the duplicates would be characterized by the formation of at least one longitudinal bur or fin corresponding with the joint. Although the knurling patent suggested a way by which some of the objections to a split mold

517 process might be overcome, it still did not represent the perfected process or one which in my opinion could be carried out commercially.

Of course, during this very active period Mr. Edison was not devoting himself exclusively to perfecting the process for duplicating phonograph records, because many applications for patents were filed relating to other branches of the art as well as to other arts and for which numerous patents were granted. One of the

518 improvements made by Mr. Edison in the summer of 1888 related to the records themselves, as he had found that records made by a chisel-like recorder and having substantially flat bottoms were very difficult to reproduce satisfactorily, since if the reproducer became tilted to any extent, it would not engage the record across its width, and the resulting reproductions would be affected and great and uneven wear of the record would take place. In order therefore that a record might be obtained in connection with which the repro-

519 ducer would automatically centre itself so as to always properly track the record, the suggestion was made by Mr. Edison of forming the record by means of a curved edge recorder, so that the record at all points would present in cross-section a portion of a circle and would vary in width and depth, and to engage with such a record he also suggested a reproducer in the form of a small sphere. These suggestions are found in Edison's patent No. 430278 of June 17, 1890 (the application for which was filed April 10, 1889). All modern talking

520 machine records of the phonograph type are now, and since the fall of 1888 have been, produced by means of curved edge cutting tools, the diameter of the recorder being about .035 of an inch or 3½ times the maximum width of the record groove. Consequently the greatest depth to which such a recorder can cut is necessarily very slight, being in practice somewhat less than .001 of an inch or perhaps less than a sheet of ordinary tissue paper. The phonographic waves thus cut in the recording surface by the curved edge recorder are several million in number for each record, and vary in width

521 from .01 of an inch to practically nothing, and in depth from less than .001 of an inch to practically nothing. Under the microscope these waves appear as more or less connected gouges of extremely complex form, but all characterized by being excessively shallow since obviously the depth of each must necessarily bear a definite relation to its width. The waves of the maximum width are considerably less than .1 as deep, while as the width decreases, the relative depth is very much less, so that it is probable that some of these excess- 522 ively minute waves are 25 or more times wider than they are deep. These records are referred to in the patent in suit as being characterized by a "shallowness of the phonographic record grooves" (page 2 lines 63–64). The provision of record grooves of this enormously complex character wherein the waves varied both in width and in depth instead of varying only in depth as with the previous records, apparently presented still further difficulties towards the solution of the problem of accurately duplicating them. 523

In the fall of 1888 the discovery was made by Mr. Edison which enabled him to achieve the long-sought-for object and obtain an absolutely exact copy of the record surface notwithstanding its complexity and excessive minuteness. That discovery consisted in the observation that by forming a record in a continuous mold or matrix, as for example by expanding a blank therein, the resulting duplicate could be contracted diametrically to a sufficient extent to clear the engaging surfaces and permit the duplicate to be withdrawn 524 without injury to the record surface taking place by reason of the longitudinal contraction which necessarily accompanies the diametric shrinkage. This discovery became possible, in my opinion, because of the fact that the extreme shallowness of the waves and the absence of any engaging vertical surfaces due to the curved cross-section of the waves themselves resulted, when any diametric contraction had taken place, in a comparatively great longitudinal clearance, so that the first effect of the contraction was to pro-

525 vide ample room for a longitudinal shrinkage without any injury to the surface. Thus it became possible to effect a sufficient diametric contraction as to completely clear the engaging surfaces and permit the duplicate to be withdrawn without encountering any difficulties due to longitudinal contraction, as would be likely to be the case with records having practically vertical walls. The announcement of this discovery is found in a caveat filed by Mr. Edi-
526 son on October 26, 1888, and which was a part of the record in the Edison-Lambert interference referred to in my previous deposition, in the following words :

> " For reproducing records, or rather duplicating the same, I coat the surface of the cylinder with, say, silver by an electro-vacuum process, then plate the outside ⅛ inch thick with copper, put the cylinder on a mandrel, true the outside by grinding to a taper, fit this in a taper steel
> 527 die, then dissolve wax or other material out, and then put in a blank cylinder of plastic (when hot) material, force in a plunger, spread the same against the record, and then allow the same to cool. *It will contract sufficient away from the record to allow of its being taken out.*"

After having made this discovery by which the problem was finally solved, Mr. Edison carried on an elaborate series of experiments for the purpose of re-
528 fining and improving the details of the operations until at the date of the application for the patent in suit the process was in a complete and practical condition, and shortly afterwards duplicate records produced by that process were used commercially in large numbers. During this experimental period of nearly 10 years the phonograph business had developed to such an enormous extent that it was no longer possible to commercially manufacture and sell *original records* at sufficiently attractive price to the public. To meet the demand the so called mechanical duplicating

529
process was developed and extensively used, wherein
a reproducer engaging with an original record was connected
with and operated a recorder engaging a blank
so as to produce a transference of the sound waves
from one to the other, as suggested in Edison's original
English patent. This mechanical process was ineffective
and the results secured were of poor quality,
but notwithstanding its defects it continued to occupy
the field until the commercial advent of duplicate
records constructed in accordance with the process of 530
the patent in suit, and at the present time all duplicate
records now made are constructed in accordance with
this process and utilize Mr. Edison's discovery which
made the process possible.

Having considered the steps which led up to the
invention of the process of the patent in suit, and replying
directly to your question, I am of the opinion
that the patent in suit stands at the foundation of the
modern art of duplicating phonograph records by
means of matrices or molds. It is the pioneer patent 531
in this art. I have already analyzed the terms of the
patent in suit by my previous deposition, so that I
need only refer to it very generally here. The invention
which it covers is of a two-fold nature, the
first part relating to the steps followed in forming the
duplicate, and the second part relating to the steps
followed in removing the duplicate from a continuous
mold however the forming process may be carried out.
The special forming process which Mr. Edison describes
consists in expanding a blank by heat into engagement 532
with the matrix surface and then applying
mechanical pressure to effect a more intimate engagement
and sharpen the impression, but the patent
points out that "the entire expansion may be effected
mechanically" (page 2, lines 54, 55), and it is also
clear that the entire expansion might be effected by
heat alone. Two of the claims, the first and the last,
are limited specifically to processes in which an impression
is secured by relying on the expansive force
of the blank, effected by heating the same for example,

533 but other claims (*i. e.*, the 4th, 5th, 9th, 10th and 17th) define the forming operation by language broad enough to include the expansion of a blank in any way, whether by mechanical expansion or by the application of heat or both. So far as the second part of the invention is concerned, the operations which are followed in removing the duplicate are set forth in the second and third claims in connection with language ("forming a hollow cylindrical plastic phonogram
534 within said mold") broad enough to include either a pressing or a casting operation. As a matter of fact, the second and third claims were suggested to Edison by the Patent Office Examiner during the prosecution of his application, for the purpose of securing an interference with an application of Joyce which specifically described a casting operation. The invention set forth in the second and third claims relating to the removal of the duplicates by diametric contraction sufficient to entirely clear the surfaces is utilized in connection
535 with all modern processes for duplicating phonograph records by means of matrices or molds, while the invention defined by the 4th, 5th, 9th, 10th and 17th claims is utilized in all modern processes for duplicating such records wherein a blank is expanded into engagement with a matrix as distinguished from processes wherein molten material is cast in a mold.

Adjourned at the request of defendant's counsel to May 17, 1904, at 11 A. M.

536

West Orange, N. J., May 17, 1904.

Met pursuant to adjournment.

Present, Richard N. Dyer, Esq., for Complainant.

(Direct Examination of Frank L. Dyer continued.)

15 Q. Please explain more fully the facts leading to the making of claims 2 and 3 of the patent in suit as

537
shown by the Patent Office prosecution, and the bearing which those facts have upon the interpretation of said claims ?

A. The interference between the application for the
patent in suit and the Lambert patent No. 645920 of
March 20, 1900, referred to in my previous deposition,
was finally decided in Edison's favor by the Assistant
Commissioner of Patents on December 10, 1901. This
interference had been pending ever since May 16, 1900,
but it had been delayed somewhat by the attempt by 538
Lambert to have it dissolved on the ground that the
Edison and Lambert processes did not interfere, but
this contention was not accepted by the Examiner and
the Commissioner, both of whom decided that while
the Edison and Lambert processes might differ in small
details, yet both involved the same patentable invention. On January 31, 1902, the Examiner in charge of
the Edison application suspended further action for
two weeks in view of additional interference proceedings, and on March 8, 1902, he suggested that Edison 539
should introduce in the application a number of additional claims, including the following :

> " The method of producing hollow cylindrical
> phonograms, which consists in obtaining a mold
> having a reverse phonogram record on the inner
> wall of a cylindrical opening, forming a hollow
> cylindrical plastic phonogram within said mold,
> releasing the phonogram from the mold by a
> difference in temperature between the mold and 540
> phonogram sufficient to entirely clear the surfaces, and removing the phonogram from the
> mold by direct longitudinal movement."

This claim, it will be noted, was identical with the patented third claim, except that with the latter the radial contraction is defined as " releasing the phonogram from the mold by a reduction in temperature sufficient to entirely clear the surfaces." By amendment in the Edison case dated March 10, 1902, the

541 claim suggested by the Examiner was introduced. On April, 24, 1902, another amendment was presented by Edison, in which the claim suggested by the Examiner was changed in the unimportant respect referred to in order "to more clearly express the invention," and the second claim of the patent was introduced for the purpose of "expressing the radial contraction of the duplicate from the matrix in somewhat broader terms."
Upon referring to the application of Maurice Joyce
542 filed April 13, 1897, Serial No. 655027, which was involved in interference with the Edison case after the final determination of the interference with Lambert, I find that he described a duplicating process in which a plastic material is cast around a tapering core in a molten condition which takes an impression from the mold in setting to the solid state. Interferences are contemplated by rule 96 of the Rules of Practice in the Patent Office which provides:

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> "Whenever two or more applications *disclose the same invention* and one of said applications is ready for allowance and contains *a claim to said invention*, the Primary Examiner will notify the other applicant of such fact, furnish him with a copy of the patentable claim, and require him to make such claim and put his case in condition for allowance within a specified time, so that an interference can be declared."

544 After the amendment in the Edison case of April 24, 1902, was filed, Joyce presented a claim corresponding with the second claim of the Edison patent by amendment of June 10, 1902, so that on that date both Joyce and Edison were claiming the broad invention of shrinking the formed duplicate sufficiently to entirely clear the surfaces and removing it longitudinally, although it will be remembered that in one case the claims applied to a casting process and in the other case to an application in which a pressing operation was described. The two applications being in this

545 condition, the interference was declared, involving as its issue the second and third claims of the Edison patent, and that interference was decided in Edison's favor.

From this it appears that the second and third claims of the patent in suit were granted by the Patent Office and accepted by Mr. Edison as covering a broad generic invention, not limited to any special method of expanding a blank, or in fact to any expanding operation, since the claims were considered to be sufficiently 546 comprehensive to actually include a process in which a blank was not utilized but wherein the material was introduced into the mold in a liquid condition.

16 Q. Please explain your understanding of the meaning of the expression "of sufficient thickness to maintain its shape during and after its engagement with the matrix" found in claim 4 of the patent in suit, and similar expressions found in claims 9, 10 and 17, and also the expression "of sufficient thickness to maintain its form under normal conditions" appearing 547 in claim 5 of the patent in suit?

The expressions in question are used in the claims for the purpose of distinguishing a process wherein the material is thick enough to receive a surface impression of the record and at the same time present a sufficient body to support the record surface and permit reproductions therefrom, from processes in which very thin material is used adapted by heat to be made pliable, so that the record shall extend substantially through the entire wall, which therefore requires an 548 independent support or backing. In other words, the expressions distinguish from a process in which the body of the material is not distorted, from a process in which the body of the material is distorted. A process of the latter type is disclosed in the British patent to J. Lewis Young No. 1478 of January 23, 1894. This Young patent was cited as a reference against the application for the first Lambert patent No. 645,920 of March 20, 1900, and in that application the essential distinction be-

549 tween the two types of processes was made by Lambert. By amendment filed in the Lambert case on November 22, 1899, the following addition to the specification was inserted :

> " In carrying out my process, it is an absolute requirement that the blank phonograms or tubes must be of a thickness to receive and retain in a perfect form the indentations of the matrix and
> 550 *at the same time have within itself a sufficient backing or support for the reproduction of the record phonographically after the formation of the record on its face and the removal of the tube from the matrix.* It is practically impossible to use very thin walled tubes or hollow cylinders for my process, because the phonographic reproduction or sound from such thin records, supposing the tubes to be capable of even temporarily maintaining or holding their shape, would
> 551 be weak, distorted, indistinct and imperfect, but *as a matter of fact the records themselves made of thin material are not capable of retaining their shape and would be impractical in actual use.* By using a relatively thick walled tube or hollow cylinder, the objections which would occur in practice with a very thin tube are entirely overcome and the produced records are a merchantable article."

552 In the same amendment Mr. Lambert in further distinguishing between the two types of processes—one using relatively thick material and the other using very thin material—submitted this argument :

> " In the Young patent a very thin hollow cylinder is required which is collapsed inwardly in order to be removed from the matrix ; while in applicant's invention the blank cylinder is, and of necessity must be, sufficiently thick to

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> receive and retain its impressions without being collapsed and without danger of warping or distorting the record, also furnishing sufficient form or backing for the phonographic reproduction of the record.
>
> "The use of a very thin substance as required in the Young patent is impracticable for several reasons. It will not receive perfect indentations, especially if they are well pronounced; it will not retain its cylindrical shape unless properly 554 backed, which is mechanically impossible; and even if such a thin record can be made, it is impossible to back and support it so as to avoid variations in its elasticity because of imperfect contact with the backing, and these variations producing corresponding imperfections in the record will impair or destroy its usefulness. *Applicant has repeatedly attempted to produce records in accordance with the Young patent, but has never been able to produce a record in any* 555 *sense practical or operative.*"

The amendment and arguments above quoted were introduced by Lambert in connection with claims in which the two types of processes were distinguished by the expression "a relatively thick cylinder or tube". On the same day (November 22, 1899) Lambert presented a second amendment in which a further refinement was made, the expression then reading "sufficiently thick to maintain its shape after disengage- 556 ment from the matrix". On January 18, 1900, the Examiner suggested a claim to Lambert in which the expression as it now appears in the Edison claims was used, namely, "sufficiently thick to maintain its shape during and after the act of disengagement from the matrix." These expressions were all based on the distinction to which Lambert had referred by his amendment and argument above quoted. This distinction also appears from the testimony of Mr. Lambert in the Edison-

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Lambert interference, from which I quote (answer to x-Q. 9):

> "Up to that time—1897—I always had trouble in mounting the records and hearing them, due to their thin wall; but the first work upon cylinders sufficiently thick *to maintain their shape for any definite period after removal from the matrix* was done in 1897."

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After the Patent Office Examiner was convinced by
Mr. Lambert of the force of the distinction between
the two types of processes, a claim corresponding to
the first claim of Lambert's patent No. 645920 was
suggested in the Edison case on January 18, 1900, and
was presented by Edison in an amendment on the following
day but which for some reason was not received
by the Examiner. The Lambert patent therefore
issued, and on April 17, 1900, the claim was again presented
559 by Edison and became the issue of the Edison-Lambert
interference. Manifestly the same distinction
between the Lambert process and that suggested by
the Young patent exists between the Edison process
and that of the Young patent, since in carrying the
Edison process into effect, the blank is of sufficient
thickness to receive and retain the impression and at
the same time present enough body to support the
record surface and do away with the necessity of using
an independent backing. Thus with the present Edison
560 records the thickness of the wall is, roughly speaking,
.180 of an inch, so that the very deepest records
are somewhat less than $\frac{1}{180}$ of the thickness of the wall.
I understand that with the present Lambert records
the walls are from .040 to .050 of an inch, so that the
very deepest impressions are from $\frac{1}{40}$ to $\frac{1}{50}$ the thickness
of the walls. In other words, with the Lambert
records the thickness of the body of material which
supports the record surface is at least 40 times as
great as the very deepest impressions which are formed
in that surface.

561 17 Q. Mr. Carter, in answer to Q. 6 of his deposition says :

> " The Edison patent in suit sets forth one of the processes which has been proposed for this purpose—although a crude one of doubtful practicability, and one which has never been reduced to a commercial basis, as I understand it, or, if so, to but a very limited extent, having been abandoned even by the patentees in favor 562
> of more satisfactory methods covered by other patents."

And in answer to Q. 39 Mr. Carter refers to Edison's patent No. 667662 issued February 5, 1901, as describing the process actually employed commercially by Mr. Edison in the manufacture of duplicate records. Do you agree with the statements of Mr. Carter contained in the matter quoted ?

A. No, sir. I should hardly call a process crude if 563
by carrying it into effect it is possible to make exact copies of such an excessively complex article as a phonograph record. Nor is there any doubt as to the practicability of the process described in the patent in in suit, because that exact process is a perfectly practicable one by which thousands of duplicate records have been made. Furthermore, the patented process, even to the specific details described, was followed on a considerable commercial basis by Mr. Edison at about the time of the filing of the application 564
for the patent. Finally, the patented process has not been abandoned in favor of more satisfactory methods, because so far as the second and third claims are concerned, the methods which they cover have been followed by Mr. Edison ever since the commercial introduction of the process in 1898, and at the present time many thousand records are made daily by this method. It is true that at the present time Mr. Edison is using a casting process such as is referred to in his patent No. 667,662,

565 since the special material which Mr. Edison prefers to use is particularly adapted for a casting operation. Since defendants continue to use celluloid (one of the materials referred to by Mr. Edison in the patent in suit), which cannot be manipulated by a casting operation, the defendant therefore continues to use the particular process of expanding a blank, which the patent in suit set forth. Undoubtedly if Mr. Edison should at any time make use of a material which could not be
566 satisfactorily cast, he would again adopt the special process of expanding a blank in a mold as suggested in the patent in suit.

18 Q. In answer to Q. 7 Mr. Carter states that the only object of heating the blank in the Edison process of the patent in suit is to cause the blank to force itself into intimate contact with the bore of the matrix so as to take the impression of the latter by its own expansive force, and he asserts that this is shown by the prosecution of the Edison application in the Patent Office.
567 Do you agree with Mr. Carter in this matter?

A. While it is a fact that in the patent in suit Mr. Edison states that the impression can be secured merely by heating the blank so that the engagement with the matrix will be secured by reason of the expansive force of the blank itself, this special suggestion is made the subject of only the first and last claims. The patent distinctly states that with

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> "blanks made of sufficiently viscous material the entire expansion may be effected mechanically by forcing a tapering mandrel within the same. (Page 2, lines 53–56.)

It is perfectly evident that with the materials referred to by Mr. Edison, the application of heat would tend to make the blanks more or less soft and viscous, and some of the claims (5th and 6th) refer to the step of "softening said blank by heat." The decision of the Examiners-in-Chief in the Edison-Lambert inter-

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ference deals also with this point and quotes from the
testimony of Mr. Edison and of his assistant Charles
Wurth showing that the application of the heat did in
fact soften the material, as of course it must. Further-
more, in Mr. Edison's very earliest disclosure of the
patented process found in his caveat of October 26,
1888, he refers to the use of "a blank cylinder of
plastic (when hot) material." The arguments made by
Mr. Edison's attorneys during the prosecution of the
application for the patent in suit and to which Mr. 570
Carter refers, were designed to distinguish the special
kind of a pressing operation suggested by Mr. Edison
from the operations of the Lioret and Young patents
in which the blank was distorted during the operation
of taking the impression. But this distinction was not
accepted by the Patent Office Examiner, who in fact
adopted Mr. Lambert's distinction so far as the Young
patent is concerned, and who in order to distinguish
from the Lioret patent suggested the limitation that
the resulting duplicate could be removed by a direct 571
longitudinal movement. The particular argument to
which Mr. Carter refers was made in connection with
the claims which were not limited to the employment
of comparatively thick blanks nor to the removal of
the duplicates by a direct longitudinal movement. The
argument did not exclude the softening of the blank
by heat, since that is an inevitable result, but was in-
tended by Mr. Edison's attorneys to emphasize a pos-
sible difference in another function performed by the
heat with the Edison process over that performed by 572
the heat with the Young and Lioret processes.

19 Q. Have you any criticism to make of the statements made by Mr. Carter in answer to Qs. 8 and 9?

A. In these answers Mr. Carter assumes that the patent in suit must be limited to a process in which the application of heat results in a sufficient expansion of the blank as to take an impression from the matrix. That this is an erroneous assumption is clear from the statement in the patent referred to in my last answer

573 that with sufficiently viscous material, the *entire expansion* may be effected mechanically. Obviously the material may be made viscous or soft by heat or by the application of a solvent.

20 Q. In answer to Q. 10 Mr. Carter makes the statement that the original application for the Edison patent in suit affords no support whatever for the statement that the blank is softened by heat. Do you agree with him in this matter ?

574 A. It is a fact that the original specification did not state in so many words that the application of heat resulted in softening the material, but with the materials mentioned by Mr. Edison (asphalt, stearic acid, stearate of soda, waxes, resins, ebonite, hard rubber, celluloid and glue) the application of heat must necessarily result in softening the material to an extent of course dependent upon the degree of heat and the character of the material. On precisely the same statements in the specification as finally presented, the 5th and 6th 575 claims were based, in which reference was specifically made to softening by heat, and these claims were accepted by the Patent Office without objection and as warranted by the disclosure of the specification. This point was fully considered in the Patent Office, since when the Lambert interference was declared the attempt was made by Lambert to have the interference dissolved for the reason, among others, that with the Edison process the blank was not softened by heat, and in support of this motion the attempt was made to effec- 576 tively rely on the same argument made by Mr. Edison's attorneys that Mr. Carter now refers to. The motion in question was first considered by the Principal Examiner, who in his opinion of August 22, 1900, in denying the motion, said :

> " Lambert's next contention is that Edison's specification does not disclose the use of a cylinder of softened material, but, on the contrary, constantly refers to his material as hard."

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After showing the fallacy of this contention and referring particularly to Edison's suggested use of celluloid, the Examiner said:

> " It is a well known property of celluloid that at very low temperatures it is comparatively hard and more or less brittle, and that as the temperature is increased, it gradually softens, reaching a state of plasticity somewhere below the boiling point of water. While, therefore, 578
> Edison may not heat his celluloid blank sufficiently to render it plastic, yet the heating would inevitably soften it more or less from the very nature of the material employed."

An appeal was taken by Lambert to the Commissioner of Patents, who on November 15, 1900, affirmed the Examiner's decision, the Commissioner saying:

> " I agree with him that when the specifica- 579
> tions are examined, the conclusion that naturally follows is, that the language warrants the deduction that both parties originally disclosed the same patentable method."

This decision of the Commissioner of Patents was under the practice final on the motion to dissolve, but after testimony had been taken the point was still raised and was passed upon by the three tribunals who had occasion to consider the merits of the controversy. 580
In considering the question, the Examiner of Interferences, in his decision of May 28, 1901, said:

> " Counsel for Lambert has also contended that there is no interference in fact between the applications of the parties for the reason that Edison employed the process in the production of wax cylinders which he heated to about 115 degrees Fahrenheit, primarily to expand them into engagement with the interior surface of the

581 matrix, which heating, as counsel for Lambert contends, does not soften the material of which the cylinders are composed. Edison contends that such heating does soften the cylinders. There has been introduced into the record no showing or proofs that the wax cylinders when heated to 115 degrees are not softened as contemplated in the issue of this interference. The Examiner is unable to find, either from the argument of counsel or from the experts in this Office, 582 any ground upon which to hold that Edison did not soften his material when it was heated to the temperature alleged."

The Examiners-in-Chief, in a lengthy opinion of August 13, 1901, also considered the point and said:

> " The wax record is hot. Being hot, it must have been somewhat softened. After it was softened by the heat, the plunger within the matrix 583 and blank effected the expanding pressure within the blank."

And again:

> " The evidence is that the blanks are softened in this process. There is no real contradiction between the averments of Wurth in his affidavit made during the prosecution of the application 584 and his testimony in this proceeding. There is a difference of opinion between him and Edison as to what constitutes plasticity. Both agree that the wax cylinder is softened for the same purpose. It is also in evidence that celluloid records were made by this process without softening the blank before it is put into the matrix; that they cannot be made by heat alone, but can be made by heat and pressure, the pressure being greater that that needed for wax cylinders."

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Finally, the Assistant Commissioner of Patents, who had occasion to decide the case on appeal, also considered the point, and in his opinion of December 10, 1901 he said:

> "Counsel for Lambert also contends that the material used by Lambert is softened previously to its being placed in the matrix mold, and that such is not the case with Edison. The essential thing is that this material, if too hard to receive the matrix impression, may be sufficiently softened to receive the same. Of course this softening must occur before the material is made to take against the matrix. It is clear that this is done in both cases. In Edison, heat is applied. It is true that Edison does not explicitly state that the material is 'previously softened.' He does state, however, that heat is applied. Now this discription is sufficiently clear to anyone skilled in the art to understand that materials such as used are softened by this application of heat. The law only requires that the description should be sufficiently clear that it may be understood by anyone skilled in the art. With this requirement Edison has fully complied." 586 587

21 Q. In answer to Q. 11 Mr. Carter expresses the opinion that the British patents to Lioret and Young disclose 588

> "the complete process of the patent in suit except possibly as this process can be regarded as limited to the impressing of a plastic record against a suitable matrix by its own expansive force."

Please first consider the Lioret patent and explain what bearing, if any, it has upon the invention of the patent in suit?

A. The Lioret patent was cited in the Edison appli-

589 cation and was fully known to the Examiner. It was also cited in the Lambert application, but arguments were presented to the Examiner which satisfied him that the Lioret patent was not a pertinent reference to the process here involved. Furthermore, distinctions were brought out in the claims of the patent in suit at the suggestion of the Examiner that fully distinguished the claims from this reference.

The Lioret process differs from the Edison process 590 in the essential respect that whereas Edison forms his original record on the ordinary cylindrical phonograph blank, Lioret formed his original record on the top of a relatively high and sharp spiral thread. This difference in the character of original masters used makes the Lioret process entirely different from the Edison process, and, assuming the Lioret process to be operative, results in the production of an entirely different kind of duplicate record from that secured by the Edison process. Since with the Lioret process the orig- 591 inal record is formed on the top of a relatively high and sharp spiral thread, a mold obtained therefrom will present the record on the bottom of a corresponding channel, so that in order to take an impression from such a mold, the impressionable material requires to be forced into and intimately engage the very bottom of the channel or groove. Assuming that an impression could be secured in this way, it will be evident that in order to remove the resulting duplicate, the latter would have to be unscrewed from the mold, and 592 this is described in Lioret's corresponding United States patent No. 528273 (page 2, line 111) which is also in evidence. Of course the expedient of unscrewing a duplicate phonograph record from the mold would be entirely impracticable in the modern art, since the duplicate would have to be revolved more than 400 times to clear it, and it would be impossible to prevent the obliteration of the record in this operation. Not only does Lioret's disclosure differ from Edison's invention in the respects that the character of the master is different, the mold is different, and the particular manipu-

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lations followed in securing the impression and removing the duplicates are different, but the two methods necessarily result in the production of different articles. A duplicate sound record obtained by the Lioret patent will necessarily have the record formed on the top of a spiral thread, and such a record could not be used in connection with any standard talking machines at present on the market or which were on the market, so far as I know, at the date of Lioret's patents. On the
contrary, by following the Edison method, a duplicate 594
record is obtained which resembles in all respects the original records secured before his invention and which were designed to be used and are used to the extent of thousands daily in connection with standard talking machines now on the market. With the Lioret process, owing to the character of mold used, it is mechanically impossible to perform the characteristic operations of the Edison process, namely, contracting the duplicate diametrically to an extent sufficient to entirely clear
the surfaces, thereby permitting the duplicate to be 595
removed by a direct longitudinal movement. On the contrary, with the Lioret process the surfaces of the phonogram and matrix or mold are not cleared, and the phonogram or duplicate is removed by unscrewing it as distinguished from a direct movement. This essential distinction between the Lioret process and a process of the Edison type not only appears on the face of the patents themselves, but was suggested by the Patent Office Examiner as patentably distinguish-
ing it, and moreover this suggestion was first made 596
to Lambert and was then made to Edison. On January 18, 1900, the Examiner in the Lambert case stated that the first claim as then presented "is somewhat awkwardly worded and the process is probably incomplete, and should also better distinguish from the patent to Lioret." He therefore suggested a claim which for the first time contained the limitation to the removal of the duplicate "by direct longitudinal movement". This suggested claim was made in the Lambert case

597 on January 22, 1900. It was also suggested to Edison on January 18, 1900, and was presented by amendment of April 17, 1900 in the Edison application.

22 Q. Does the Lioret patent, in your opinion, describe an operative and practicable process for securing duplicate phonograph records—giving your reasons for your views.

A. It does not. I have attempted experimentally to carry on the operations described by Lioret in his
598 United States and British patents, but without success. I first had a regular standard phonograph changed with a feed screw of about 20 threads per inch and had a recorder mounted therein provided with a stylus held rigidly against lateral movements, so that it would accurately track the top of a sharp thread. I also had a number of soft steel blanks made as suggested by Lioret, cut with the proper thread, having the proportions illustrated in the Lioret patents and a pitch of 20 threads per inch, and
599 on top of this thread a phonograph record was formed. The steel master thus obtained was then hardened and put in a plating bath so as to receive a deposit of copper. In order that the bath might not affect the steel, a cyanide solution was used. Lioret in his United States patent says:

"I remove this tube from the matrix cylinder by first heating it externally to expand it sufficiently to enable it to be unscrewed from the said cylinder, the impression being so slight that very little expansion is
600 necessary." (Page 2 line 92 *et seq.)*

I found it absolutely impossible to separate the copper deposit from the steel master as Lioret suggests, even when the copper shell was heated with a gas flame, wet rags were applied to the steel master and the latter was clamped in a heavy vise and the copper deposit engaged by a powerful Stilson wrench. The shell would not separate from the master, but the two were as intimately engaged as if welded together. I present the master with the copper deposit thereon, 601 from which it will be seen that the two are considerably scarred in the effort to separate them.

> Offered in evidence and marked "Complainant's Exhibit Lioret No. 1."

The attempt was then made to coat a second steel
master with graphite in the hope that a slightly yielding
film would be formed between the master and the
deposit to permit the deposit to be removed. For this 602
purpose the steel master was coated with a solution of
beeswax and benzol, so that when the benzol evaporated,
a thin film of beeswax would be left on the
master, but not sufficiently thick to fill up the record.
This wax film was then evenly rubbed with graphite
to give a conducting coating, and the master thus prepared
was put in the cyanide bath. It was immediately
found that the cyanide solution appeared to dissolve
the wax so that the graphite floated to the surface.
This was therefore impracticable. I then 603
turned my attention to plating the steel master in an
acid solution, although this would be naturally very
objectionable since the acid would attack the steel and
injure the record surface. The master was therefore
again coated with beeswax and treated with graphite
and then plated with copper in an acid bath, but it
subsequently developed that the wax film was too thin
to resist the acid, which attacked the steel and practically
ruined the record surface. It would have been
impossible to use a thicker film of wax without completely 604
filling up the record. I found it possible, although
very difficult, to remove the copper deposit obtained
in the acid bath by the use of a Stilson wrench
with the application of heat to the copper deposit and
of cold to the master, but the master was very badly
attacked by the acid, and in removing the mold the
record surface was completely destroyed by reason of
the efforts exerted in unscrewing it. These experiments
which I have so far described convince me that
it is a mechanical impossibility to make a mold as

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Lioret suggests in his patents without completely
destroying the record surface.

I then attempted to make a mold which should cor-
respond with that described by Lioret by employing a
wax master, and for this purpose had several wax mas-
ters prepared, formed with the same spiral thread on
their surfaces. One of these masters was recorded
upon in the machine described, the record being
formed on the top of the thread as suggested by Lioret,
606 and the master thus obtained was first coated with gold
and then plated with copper. The copper deposit was
then backed up with a brass ring so as to form a com-
plete mold. It was found that the master could not
be removed by shrinking and unscrewing it, as might
be supposed, since the longitudinal contraction
firmly engaged the threads of the master and mold and
prevented a separation of the two. Consequently it
was necessary to break out the master. I present the
mold in question and also a fragment of the master
607 from which it was made.

> Offered in evidence and marked "Complainant's Exhibit Lioret No. 2" and "Complainant's Exhibit Lioret No. 3."

Having obtained an apparently satisfactory mold in
this way, I then attempted to make duplicates there-
from, and for this purpose I had a number of celluloid
blanks turned down to the right size, formed with
608 tapering bores, and also had a tapering core made so
as to expand them. I present one of these blanks and
also the core with which I experimented.

> Offered in evidence and marked "Complainant's Exhibit Lioret No. 4" and "Complainant's Exhibit Lioret No. 5."

One of these blanks was then inserted in the mold, the core was introduced in the blank, and the whole was immersed in very hot water until the blank became

609 plastic, after which the core was driven in by a heavy screw press while the parts were still submerged. In this way the celluloid was displaced so as to enter the spiral channel formed in the mold and presumably to engage with the record formed at the bottom of that channel. After these operations, as described in Lioret's United States patent, the latter continues :

> "I then plunge the whole into cold water and the celluloid recovers its hardness and is at the 610 same time generally contracted sufficiently to permit the easy withdrawal of the ring *c* from the mold *a′* by unscrewing it therefrom."

I found it absolutely impossible to perform this operation even when the mold and duplicate therein were put on ice and a great contraction secured. The difficulty resided in the fact that the *longitudinal shrinkage* of the duplicate caused the threads to jam tightly together and prevent the duplicate from being 611 removed. The duplicate was absolutely wedged into the mold, and I was able to remove it only by forming two keyways on its bore, engaging a brass key with such ways, putting the key in a vise, and unscrewing the mold by a Stillson wrench. This operation was very tedious and probably required half an hour's hard work. The duplicate obtained in this way is very badly disfigured, a part of the thread being stripped off, at one point a part of the mold was actually carried away by the record, and the record surface is of course 612 worthless. I present this duplicate herewith, from which its useless character can be observed.

Offered in evidence and marked "Complainant's Exhibit Lioret No. 6."

The experiments which I have thus described satisfy me that the process set out in the Lioret patents is inoperative for two reasons: FIRST, a mold cannot be made as Lioret suggests without a practical oblitera-

613 tion of the record surface. SECOND, even if a mold could be made, the duplicates could not be removed therefrom without material, if not total, injury to the record surface. Furthermore, with the Lioret process there is nothing to prevent water from entering the space between the blank and mold, which would prevent an intimate engagement with the record surface on account of the inevitable entrapping of water bubbles.

614 Adjourned to May 18, 1904, same time and place.

WEST ORANGE, N. J., May 18, 1904.

Met pursuant to adjournment.

DIRECT EXAMINATION OF FRANK L. DYER CONTINUED:

615 23 Q. Now please consider the Young British patent and state what bearing, if any, it has upon the patent in suit?

A. The Young patent, like the Lioret patents, was also before the Examiner during the prosecution of the Edison application as well as of the original Lambert application, and the claims were allowed with that reference directly in mind. In describing his process, Young obtains a mold in the manner suggested by Mr. Edison in his 1892 patent, namely, by coating an
616 original master record with graphite, electroplating thereon, backing up the electroplate, and removing the original master. Having secured a mold in this way, Young expected to obtain duplicates therefrom by introducing within the mold a "*very thin* hollow cylinder" of material capable of being collapsed, buckled or folded inwardly, such as celluloid, xylonite or vulcanite. The patent states that this tube is "of the same size externally as that of the original wax cylinder upon which the record was first taken" and consequently such a tube would by *slightly larger* than the

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bore of the mold. The mold is now "warmed or slightly heated by any convenient means" and the very thin collapsible blank is then inserted within the mold, this being no doubt possible by reason of the slight expansion of the mold in being heated, but being certainly possible by first collapsing the blank and then introducing it within the mold. The blank is then "rendered *pliable* by a gentle heat (which may be that given off by the heated electro and its casing)" 618
and is then pressed "gently and evenly up to and against the face of the electro" so as to take an impression. The Young patent is entirely silent as to any suggestion of means by which this pressure is secured, nor does it point out whether the pressure is obtained simultaneously on all parts of the blank or progressively on different portions thereof. Having thus obtained an impression on the very thin collapsible blank, the operations followed in removing it are thus described:

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> "When the said plastic cylinder has cooled, I am enabled, *by slightly collapsing this inwardly*, to cleanly and easily remove it from the electro."

Of course, dealing with a very thin collapsible blank, and *particularly with a blank which normally is slightly larger than the bore of the mold*, these operations are necessary. After the duplicate has been thus secured, 620
it is returned to its tubular form as accurately as may be possible, and is then mounted on a cylindrical base of the same character as the original record, thereby forming a *composite article* capable of use on standard talking machines. Aside from the fact that the description of the Young patent is very meager and obscure, the Young process is fully distinguished from the Edison process in the following respects:

First, with the Edison process the blank employed is relatively thick, so that the impression is

621 formed on the surface thereof while the bulk of the material acts as a support for the record and permits effective reproduction from the duplicate. With the Young process a very thin blank is employed, which is made *pliable*, so that the blank as a whole follows the sinuosities and undulations of the record surface, and consequently reproduction cannot be secured without subsequently supporting the duplicate 622 on a proper backing. In other words, with the Edison process the blank used is sufficiently thick to maintain its shape during and after the act of engagement with the matrix, whereas with the Young process the blank in the act of being forced against the matrix surface is distorted and changed to accord with the variations of the record surface.

Second, with the Edison process the duplicate, after it has been formed, is contracted diametrically 623 so as to clear the engaging surfaces and thereby permit the duplicate to be removed without changing its cylindrical shape. With the Young process the very thin duplicate is removed by collapsing or bending it inwardly, which necessarily requires that the duplicate shall be returned to its original shape before it can be used. In other words, with the Edison process the duplicate is removed by first changing its size or diameter without changing its shape; 624 whereas with the Young process the duplicate is removed by changing its shape without changing its size or diameter.

Third, by the Edison process a duplicate record is secured as a single homogeneous article having an impressed record surface and an integral body or support therefor which may be made many times the thickness of the very deepest impressions. With the Young process a composite record is obtained, in which the record surface is separate from the body or support. Since it

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> would be impossible to secure an absolutely accurate fit between the thin celluloid shell of the
> Young process and the backing therefor, the
> record surface would be more or less fugitive,
> and under the weight of the reproducer stylus
> would tend to be smoothed or ironed out.
> Furthermore, with the Young process the support is described as being of a different material
> from the record surface, so that under variations of temperature the materials would shrink 626
> or expand unevenly, and if the support should
> expand to a greater extent than the record
> surface, this would also tend to obliterate the
> record surface.

For these reasons I do not regard the Young patent
as disclosing or anticipating the material features of
the invention of the patent in suit. These differences
between a successful duplicating process and that
suggested by Young were recognized by Mr. Lambert, 627
against whose original application the Young patent
was cited. For instance, in an amendent filed in
the Lambert case on October 16, 1899 it was said:

> " We submit that this English patent does
> not show an operative process for producing
> the record of applicant, or a satisfactory record
> —one that will meet the requirements of commerce—and that, being inoperative or a mere
> paper reference, it cannot stand in the way of 628
> applicant."

And again in amendment filed October 22, 1899 the matter which I have previously quoted was added to the Lambert specification, pointing out as

> " an absolute requirement that the blank phonograms or tubes must be of a thickness to receive and retain in a perfect form the indentations of the matrix and *at the same time have*

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> *within itself a sufficient backing or support for the reproduction of the record phonographically after the formation of the record on its face and the removal of the tube from the matrix.*"

24 Q. Do you regard the Young patent as describing a practically operative process for the manufacture of phonographic duplicate records—giving your reasons for any views you may express.

630 A. No, I do not regard any process as being practically operative that involves a sufficient collapsing of its walls to permit it to be removed from a matrix and a necessary restoration to its original form, because these operations would be liable to injure the delicate surface. Neither do I regard a process as practically operative that necessitates the mounting of a very thin shell on a support or backing, because in that case the record would be weak, uncertain, more or less fugitive, and become gradually obliterated. This fact 631 is recognized in the original Lambert patent, which states :

> " It is practically impossible to use very thin walled tubes or hollow cylinders for my process, because the phonographic reproduction of sound from such thin records, supposing the tubes to be capable of even temporarily maintaining or holding their shape, would be weak, distorted, indistinct, and imperfect ; but as a matter of fact the records themselves made of thin material are not capable of retaining their shape and would be impractical in actual use." 632

And as was stated in the argument in the Lambert case filed November 22, 1899 :

> " Applicant (Lambert) has repeatedly attempted to produce records in accordance with the Young patent, but has never been able to produce a record in any sense practical or operative."

633 25 Q. Did Mr. Lambert, in his testimony in the interference case, furnish any support for your opinion as to the operativeness of the Lioret and Young processes ?

A. I am further confirmed in my opinion that the processes described in the Lioret and Young patents are inoperative by the testimony of Mr. Lambert in the Lambert-Edison interference. In Mr. Lambert's rebuttal testimony in that interference I find the following questions and answers : 634

> " x-Q. 17. Does the Young patent describe a process for making celluloid records ?
>
> " A. I do not consider it to be operative."
>
> * * * * *
>
> " x-Q. 20. Do you make the same answers with reference to the Lioret patent ?
>
> " A. Yes, with the exception—if one can use
> a comparative term—that it is even more in-
> operative than the process described in the 635
> Young patent."

26 Q. In answer to Q. 12 Mr. Carter refers to arguments which were made in the prosecution of the Edison application to distinguish over the Lioret and Young patents. What bearing, if any, does this matter have, in your opinion, upon the issues of the present case ?

A. None that I can see. The arguments which Mr.
Carter quotes were presented by Mr. Edison's attor- 636
neys in connection with claims which were entirely different from the claims which are here involved, inasmuch as they were not limited to the use of material sufficiently thick to maintain its shape during and after engagement with the matrix, nor were they limited to the diametric shrinkage of the formed duplicate to an extent sufficient to clear the engaging surfaces, nor were they limited to the longitudinal withdrawal of the duplicate. The claims in support of which these arguments were presented related to the manner of

637 taking the impression without regard to the character of the blanks, whether relatively thick or very thin, or to the way in which the duplicates were removed, whether by diametric shrinkage or by collapsing or by unscrewing. The distinction which Mr. Edison sought to make in this respect over the Lioret and Young patents was that with the references the material required to be *necessarily* heated to an extent which would permit the material to be displaced or distorted,
638 whereas with the Edison method, since a mere surface impression was taken, it was not necessary to carry the heating to such an extent. On this point, however, the Patent Office did not accept the distinctions as presented in these arguments, although later the Examiner accepted the distinction proposed by Lambert over the Young patent, namely, that the blank should be sufficiently thick, etc., and the Examiner himself suggested the distinction over the Lioret patent that the duplicates were withdrawn by a direct
639 longitudinal movement. These latter distinctions are the ones which appear in the claims of both the Edison and Lambert patents, and the patent in suit was granted in view of these distinctions rather than in view of the distinctions which were urged in the arguments quoted by Mr. Carter.

27 Q. In answer to Q. 12 Mr. Carter suggests that the naming of celluloid in the Edison patent as one of the materials which might be employed was manifestly simply a blind attempt to extend the scope of his in-
640 vention. Was celluloid an unknown material for receiving records in the phonograph art?

A. On the contrary, celluloid was a very well known material from which to make phonograph records at the date of the application for the patent in suit. Not only had it been suggested in the Lioret and Young patents, but as early as June 18, 1887, an application was filed by Herrington which issued February 12, 1889, No. 397,856, in which celluloid is referred to as a suitable material from which to make a celluloid

641 record, the record being made in the material after the latter had been first softened by the application of a solvent. In this patent Herrington suggests the use of ether for softening the celluloid. And in a later patent dated March 12, 1889, No. 399,265, Herrington suggests the making of *duplicate* records of celluloid, the latter being softened by the application of heat at the time of receiving the impression. These Herrington patents not only show that long before the application for the patent in suit, celluloid had been suggested as a suitable material from which to make original or duplicate phonograph records, but also show that this material could be softened by heat or by the use of a solvent prior to receiving the impression, and therefore would be an obviously useful material with the Edison process of the patent in suit even if Edison had not mentioned it in the patent in suit. 642

28 Q. In answer to Q. 13 Mr. Carter refers to an argument advanced in prosecuting the application for the patent in suit *i. e.* that the heating of the blank in the Edison process does not soften the blank but operates solely to cause the blank to take the impression of the mold by its own expansive force—and says that while a soap record may be printed by its own expansive force, a celluloid record cannot be so printed. Has this distinction any bearing upon the invention of the Edison patent as covered by the claims here in issue ? 643

A. Not in my opinion, The distinction is embodied only in the 1st and 18th claims and is not embodied in the claims here in issue. I have called attention to the fact that the patent in suit states that the entire expansion may be secured mechanically when the material is sufficiently viscous, and it is evident that the application of heat would in fact tend to soften the celluloid so as to permit an impression to be secured. This would be so even if Herrington had not suggested 10 years before the ap- 644

645 plication for the patent in suit that celluloid could be softened sufficiently to take a phonographic impression by the application of heat or of a solvent. This same distinction was raised by Lambert in the Edison-Lambert interference, and, as I have already pointed out, all the tribunals of the Patent Office—the Primary Examiner, the Examiner of Interferences, the Examiner's-in-Chief, the Assistant Commissioner, and the Commissioner in person—decided that Edison's
646 invention was embodied in a process wherein heat was used to soften the blank, which was then expanded mechanically.

29 Q. In answer to Q. 13 Mr. Carter expresses the opinion that the process of making the mold described in the Lioret patent is operative, and he criticises the showing of inoperativeness of this feature of the Lioret process made during the prosecution of the Edison application. Do you agree with him in this matter?

647 A. No, sir, I do not. Mr. Carter's opinion seems to be based entirely upon a reading of the Lioret patent, while my opinion is based on elaborate and careful experiments. I state without any qualification that it is impossible to make a mold in the manner suggested by Lioret. Mr. Carter appears to suppose that by increasing the difference in temperature between the copper shell and the steel master, or by increasing the diameter of the master and shell, a sufficient separation can be secured to permit the mold to
648 be screwed off, but he forgets that this increase in temperature will necessarily result in a corresponding longitudinal expansion of the mold relative to the master to thereby lock the two even more firmly together. He also expresses the opinion that any tendency of the mold to adhere to the master can be overcome "by applying a suitable coating to the cylinder before electro-plating it," but my experiments showed the impossibility of doing this. He finally expresses the opinion that "it would obviously be possible to

649 dissolve out the original steel record from the galvanoplastic mold by the use of appropriate acids." Nothing of this kind is suggested by Lioret and I do not know whether it would be practicable or not, but if it could be done it would be an excessively tedious operation, requiring weeks and possibly months to accomplish it.

30 Q. Mr. Carter in answer to Q. 13, while apparently agreeing with the position that the presence of water between the blank and the mold in the Lioret process 650 would interfere with the formation of a perfect imprint on the blank, suggests that this could be obviated by a simple expedient. What is your view on this matter?

A. On this point Mr. Carter says that

> "it would be a simple minded mechanic indeed to whom, if he found any difficulty of this kind, it would not instantly occur to temporarily seal the joint between the ends of the 651 mold and the matrix, as by a suitable insoluble wax, so as to prevent the water from entering the device."

Mr. Carter, however, forgets that in thus providing the seal for preventing the admission of water, he effectively prevents the expulsion of air, which would be just as objectionable as water, and becoming entrapped would prevent the material from intimately engaging the record surface of the matrix. This is a 652 very important consideration in this art, as it is strictly necessary that the blank should be brought into absolute contact with the record surface. Mr. Philpot, testifying for defendant, refers to this very point, and explains the difficulties that were first met with in defendant's operation:

> "The steam and water were continually getting behind the celluloid tube, and the waste and loss of material was very great." (Q. 6).

653 And in speaking of the original Lambert process in this same answer, he criticises it

> "because there was no means set forth in the Lambert process for permitting the air, steam and water that might be confined to the surface of the celluloid cylinder and the bore of the matrix to escape."

654 31 Q. In his answer to Q. 13 Mr. Carter also expresses the opinion that the criticisms of the Young patent made during the prosecution of the Edison application as involving a collapsing or buckling operation as distinguished from a diametric contraction, are unfounded and absurd. What is your view of this matter?

A. I regard Mr. Carter's opinion on this point as entirely unfounded and as having no support by any considerations in this case. Up to the time of Mr.
655 Carter's deposition there had never been a question but that with the Young process the duplicate record was collapsed and was not contracted radially. The Young patent states that the duplicate is removed by "slightly collapsing" it. Edison, in the prosecution of the application for the patent in suit, called attention to this fact. In the application for the Lambert patent the applicant in his amendment of November 22, 1899, stated that with the Young process the duplicate "is collapsed inwardly in order to be removed from
656 the matrix." This distinction was accepted by the Patent Office Examiner in the prosecution of the Edison and Lambert applications. The Primary Examiner, in his letter of July 27, 1898 in the Edison case, stated that with the Young process "the blank is collapsed in order to take it from the mold." Furthermore, in the Messer patent No. 705,772 of July 29, 1902, owned by the defendant and covering its present apparatus, the distinction between shrinking and collawsing is fully recognized in the statement that when the duplicate has "cooled and *shrunk*, it is easily re-

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moved *without collapsing*" (page 2, lines 38, 39). When the defendant was endeavoring to have the Court set aside the preliminary injunction granted in this case, it asserted that with its process the duplicates were in fact collapsed or bent inwardly to remove them from the mold. The purpose of this assertion was obviously to show that defendant was using the Young process as everybody understood it, wherein the records are collapsed, and not the Edison process, which the defendant was charged with infringing, 658 wherein the records are contracted diametrically. Thus Mr. Philpot, in his deposition for complainant of July 1, 1903, was asked by defendant's counsel

> " x-Q. 54. I would ask you if in removing this cool cylinder you do not frequently, if not entirely, have to collapse or bend the tube slightly to force it out of the matrix ?
>
> " A. That is part of the process."

* * * * * 659

> " x-Q. 59. I am talking about the step of the process which is described as ' the disengaging action ' ; does the thin cylindrical phonogram maintain its shape during the act of disengagement, or does it bend or collapse slightly inwardly during the act of disengagement ; which of these steps is true ?
>
> " A. It is collapsed slightly during the act of disengagement."

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And again, in answer to questions by complainant's counsel, he said :

> " R-Q. 62. As a matter of fact, it does contract sufficiently to disengage the outer surface of the celluloid tube from the wall of the matrix ?
>
> " A. It disengages sufficiently with a pressure and a slight collapsing to allow us to remove it from the matrix.

661 "R-Q. 63. Didn't it disengage sufficiently in some or most cases, so that it could be pushed out of the matrix without collapsing?

"A. We find in most of these cases that we do not have a full print on our record.

"R-Q. 64. With that qualification, you answer the last question in the affirmative?

"A. We have to discard records that come out in the way described by Mr. Dyer" (complainant's counsel). 662

Finally, when I visited defendant's factory and saw its operations on July 23, 1903, it was represented to me that in order to remove defendant's records, it was necessary to collapse them slightly, and although the attempt was made to do this, it was evident that this was a mere trick to make it appear that defendant was not infringing the Edison patent. It now appears to be admitted, both by Mr. Carter 663 and by Mr. Philpot in a later deposition, that with defendant's process no collapsing or bending of the duplicate is necessary or is employed to enable it to be removed. I therefore regard Mr. Carter's opinion on this point as being expressed for no other purpose than that of expediency and to meet the exigency of defendant's case, but that opinion finds no support either in the Young patent or in any of the proceedings which have so far been had. As a matter of fact the exactly contrary view has been maintained by everyone up to 664 this time, including the parties hereto as well as the Patent Office.

32 Q. Do Mr. Carter's experiments made to support his opinion that the Young records would inevitably shrink out of the mold warrant that conclusion?

A. No, sir, they do not. Mr. Carter describes no experiment which complies with the conditions set forth in the Young patent. In the first place, the Young patent states that the blank is "of the same size externally as that of the original wax cylinder upon which the record was first taken," and con-

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sequently somewhat larger than the bore of the matrix.
With the alleged Young experiments performed by Mr.
Carter the blank was somewhat smaller than the
matrix, so that at normal temperatures it could be
readily introduced within the same. In the next place,
the Young patent states that the blanks used are
"*very* thin," from which Mr. Lambert understood and
I understand that the Young patent has reference to a
filmlike blank, since it required to be supported on a
separate backing with all the objections incident to 666
that practice, and was capable of being made pliable
by the "gentle heat" given off by the mold
which had been merely "warmed or slightly heated,"
and in this pliable condition caused to partake
throughout its thickness of the variations and sinuosities
of the record surface. I do not understand that
the so-called Young records made by Mr. Carter were
mounted on separate backings, but gather from his
deposition that the records were stiff enough to have a
flange turned at the ends, by which they would be sup- 667
ported on the mandrel of the phonograph so that the
surface would be self-sustaining under the phonograph
reproducer. If this was so, the so-called Young records
were made of a material thicker than that contemplated
by the Young patent. In the next place,
the Young patent is quite silent as to the means employed
for pressing the blank against the record surface,
and in fact, as I have pointed out, the patent does
not even state that the pressure should be exerted
simultaneously over the entire surface. Mr. Lambert 668
recognized the necessity for doing this, because in his
first patent he states:

> "It is to be understood that in applying pressure to the interior of the tube or cylinder for forcing the same outwardly and against the face of the matrix that such pressure must be simultaneously exerted over the entire surface of the tube or cylinder and in a uniform manner so as to simultaneously force the entire exterior sur-

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> face against the interior face of the matrix, for if otherwise there would be great danger and liability of a flow of material and a consequent distortion therefrom, producing an imperfect record."

Yet Mr. Carter, in following the instructions of the Young patent, made use of the perfected Lambert apparatus, wherein the pressure is applied in this desir-
670 able way and wherein steam is first used to soften the blank and compressed air under high pressure is then employed for securing the final pressure. I understand that this Lambert apparatus was developed in its present form only after a long series of experiments, and in fact Mr. Philpot states that at one time the defendant Company contemplated abandoning the enterprise as hopeless. In the next place, the records used by Young were so thin that the material could be made pliable by the "gentle heat" given off from
671 the mold which had been merely "warmed or slightly heated". Yet in his experiments Mr. Carter admits that the celluloid was heated by steam at a pressure of 40 pounds having a temperature from 275 to 290 degrees Fahrenheit, as he states in his answer to question 31. I note that in answer to question 30 Mr. Carter expresses the opinion that the "gentle heat" referred to by Young would be somewhat less than 300 degrees Fahrenheit; and he finds support for this assumption only by comparing it "with the fierce heat
672 of a flame or furnace, for example, which would be measured in many hundreds of degrees running into the thousands." It seems to me that a reference to the fact that a mold is "warmed or slightly heated" cannot contemplate such a relatively high temperature as 300 degrees Fahrenheit, and in fact I have myself made celluloid records from material very much thicker than that contemplated by Young, in which a dry heat of less than 200 degrees Fahrenheit was employed. With the very thin records described by Young the material would be made pliable at an even

673 lower temperature, so that I see no reason why the expression " warmed or slightly heated " should not be given its ordinary meaning and refer to a temperature which could be readily borne by the hand. In the next place, in Mr. Carter's experiments the reduction in temperature to which the duplicate was subjected was very much more than that contemplated by Young, being in fact more than 200 degrees Fahrenheit, whereas with the Young process " dealing with a gentle heat " and with a " warmed or slightly heated " 674 mold, the reduction in temperature which takes place in cooling the duplicate would probably be less than 100 degrees and might not be more than 50 degrees. In the next place, the Young patent states that the duplicates are removed by collapsing them, whereas with Mr. Carter's experiments, owing to the special conditions under which the experiments were conducted, the temperatures employed, the thickness of material used, and the relation in size between the blank and the mold, the duplicates were contracted 675 diametrically and removed longitudinally. Finally, the Young patent points out that after the very thin cylinder has been removed from the matrix with the record impressed therein, it is mounted on a separate backing or support, the obvious objections to which are pointed out by Mr. Lambert in his first patent. Yet with the so-called Young records made by Mr. Carter I do not understand that this was done, but that instead of this expedient the records were provided with end flanges, as with defendant's records 676 herein.

Adjourned to May 19, 1904, same time and place.

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West Orange, N. J., May 19, 1904.

Met pursuant to adjournment.

Present,
Richard N. Dyer, Esq., for Complainant.
Thomas F. Sheridan, Esq., for Defendant.

Direct Examination of Frank L. Dyer continued:

678 33 Q. Does Mr. Carter's experiment with "Defendant's Exhibit Young Record No. 4" referred to in his answer to Q. 15 add anything to the situation?

A. No, sir. In making the exhibit in question Mr. Carter left off the end flanges and mounted the tube on the regular Lambert blank, both of which were then introduced into the matrix and subjected first to the effect of steam and then to compressed air. Of course nothing of this kind is even remotely suggested in the Young patent, and I do not see any material 679 difference from this particular experiment and the ordinary manufacture of celluloid records as commercially carried on by the Lambert Company. What Mr. Carter did was to make a composite record in one operation, differing, however, from the composite record of the Young patent in the respect that the entire article was composed of the same material. The experiment made by Mr. Carter was substantially the process described and claimed in patent to Petit No. 689,408 of December 24, 1901, wherein a very thin 680 celluloid shell is first applied to the matrix and a celluloid backing is then united thereto under the effect of steam and compressed air. Mr. Carter's experiment manifestly cannot have been contemplated by Young, since the Patent Office issued this independent patent on substantially the process that was carried on by Mr. Carter. Manifestly the operations followed in making "Young Record No. 4" were even less suggestive of the Young process than the operations followed in making the other alleged Young exhibits.

681 34 Q. In answer to Q. 16 Mr. Carter expresses the opinion that under some conditions contemplated by the Lioret patents it would not be necessary to unscrew the duplicate in removing it from the mold. Do you agree with this view?

A. I do not agree with Mr. Carter in this respect. He calls attention to the statement in the United States patent that

> "the threads of the matrix are very fine in practice and are very much exaggerated in the drawing to facilitate the illustration;" 682

and assumes that by using threads about $\frac{1}{64}$ of an inch in depth, a sufficient diametric contraction could be secured to fully clear the engaging surfaces. It is a sufficient reply to this contention to call attention to the statement in the United States patent—which is much more full and complete than the British patent—that the duplicate is unscrewed from the mold. While 683 undoubtedly Lioret intended to use finer threads than those shown, for example, in figures 1, 2 and 3 of his U. S. patent, and possibly as fine as those shown in figure 10 of this patent, he apparently did not intend to use threads of a substantially different form from those illustrated, namely, of substantially equal depth and width. In fact, although the patent contains different views taken on varying scales, some showing the threads as being quite large and others as relatively fine, it is a significant fact that all the views show 684 substantially the same form or shape, namely, threads having a relatively sharp thin edge. Such a thread is described in the patent as one having a "triangular cross-section of suitable fineness" (page 1, lines 65, 66) presenting a "slight thickness of metal" (line 74) with a "sharp edge" (lines 80, 81). If, therefore, a relatively sharp narrow thread is used, it is quite immaterial whether it be fine or coarse, since obviously the longitudinal contraction would have the same effect in one case as in the other

685 and would result in injury, if not destruction, to the record surface, as I determined by my experiments. It will of course be understood that in carrying out the Lioret process the difficulties are greatly increased by reducing the size of the thread, since it is a very difficult matter to so adjust a recorder that it will travel on top of a fine thread.

35 Q. In answer to Q. 17 Mr. Carter expresses the opinion that the contention that the process of the
686 patent in suit is distinguished from the Young patent in the respect that Edison uses a blank "sufficiently thick to maintain its shape during and after the act of disengagement from the matrix", can be accepted as offering a basis for such distinction only upon the theory—

> "that the Edison process contemplates, and is strictly limited to, the printing of the record lines upon the surface of the blank by the
> 687 pressure of its own expansive force through heating."

Do you agree with this view?

A. I do not, but I have previously called attention to the fact that Mr. Edison's suggestion of taking an impression by the expansive force of the blank is embodied only in the first and last claims, which, by the way, are not limited to the employment of a blank "sufficiently thick to maintain its shape during and
688 after the act of disengagement from the matrix." As I have previously said, the patent in suit makes it perfectly clear that when the material is sufficiently viscous, the entire impression can be secured mechanically, and the grant of the claims by the Patent Office, as well as the proceedings connected with the Edison-Lambert interference, show beyond any question that Mr. Edison's invention contemplates a process in which a blank is softened by heat and is then expanded mechanically. The expression which you quote and which was introduced into the claims repre-

689 sents a distinction, or rather two distinctions, over the Young patent which were first observed by Mr. Lambert and by him called to the attention of the Patent Office. Those distinctions are :

FIRST. That with the Young process the duplicate is removed by collapsing it, while with the Edison process (and in this I include that practiced by defendant) the duplicate is contracted diametrically so as to be withdrawn by a direct longitudinal movement. In other words, the Edison blank is sufficiently thick to main- 690 tain its shape " during " the act of disengagement from the matrix.

SECOND. With the Young process the blanks are so thin that the records are " weak, distorted, indistinct and imperfect " (Lambert patent No. 645920), whereas with the Edison process the blanks are sufficiently thick " to receive and retain in a perfect form the indentations of the matrix and at the same time have within itself a sufficient backing or support for the reproduction of the record phonographically after the 691 formation of the record on its face and the removal of the tube from the matrix " (same patent). It will be remembered that Mr. Lambert stated that he had " repeatedly attempted to produce records in accordance with the Young patent, but has never been able to produce a record in any sense practical or operative ", and in the Edison-Lambert interference (page 20, x-Q. 9) he said that it was not until 1897 that he commenced his " first work upon the cylinders sufficiently thick to maintain their shape for any definite 692 period *after* removal from the matrix." In other words, with the Edison process the blanks are sufficiently thick to maintain their shape " after " the act of disengagement. Of course this second distinction between the Edison and Young processes resides in the fact that the effect on the blank is quite different in the two cases—with the Young process the very thin blank is made pliable so that in taking the impression its wall follows the undulations of the record in very much the same way as that shown in figure 3 of

693 the Petit patent No. 689408 which I have before referred to, whereas with the Edison process a mere surface impression is taken which has no effect on the bulk of the material which is therefore free to act as a support or backing without the necessity of employing a separate support. Apparently Mr. Carter places no significance whatever on the words "and after" which appear in the quotation, and he finds no distinction between the expression as thus consid-
694 ered by him and the operations described by Young only because in his experiments with the Young process he neither had the conditions which Young sets forth, nor did he carry out the operations which Young describes.

36 Q. In answer to Q. 19 Mr. Carter in explaining the object of the end flanges in defendant's celluloid record, states that one object is—

> "to give the necessary rigidity and strength to
> 695 the record, the cylindric wall of which is too thin to properly support itself except as thus strengthened."

Do you think Mr. Carter is correct in this matter?

A. I do not think that he is correct in this respect, and to support my views I present a Lambert record No. 799 with the mark "Pat'd July 29, 1902" thereon, from which it will be seen that the wall presented is relatively stiff and rigid, so that no backing is neces-
696 sary to support it, since the material offers of itself the necessary support for the record surface. As I have previously said, the body of material presented in this record for supporting the record surface is from 40 to 50 times the depth of the very deepest impressions and is probably several hundred times the depth of many of the impressions. Such a tube with the end flanges cut off is not collapsible in the sense that that expression is used in this art. In fact, the Messer patent, whose date appears on this ex-

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hibit, states that the record "is easily removed without collapsing."

> Lambert record produced by the witness, and the end flanges cut therefrom, offered in evidence and marked "Complainant's Exhibit Lambert Record and separated End Flanges".

37 Q. In answer to Q. 23 Mr. Carter expresses the opinion that the feature of the Messer patent consist- 698
ing in sealing the joint between the blank cylinder and the top and bottom plates by means of integral flanges turned in from the body of the blank itself "is really the keynote to a successful commercial process of producing celluloid records". Do you agree with this view of the importance of the Messer patent?

A. The Lambert patent No. 742454 of October 27, 1903, to which Mr. Carter refers describes the entire process as now carried out by defendant, but in that
patent the blank is not provided with inturned ends. 699
Celluloid blanks with inturned ends were, however, known long before the application for the Messer patent, being described in the patent to Petit No. 657956 of September 18, 1900, application filed November 15, 1899. In patent No. 689118 of December 17, 1901, also prior to the date of the application for the Messer patent, Petit describes a process for making celluloid duplicates by first subjecting the blank to the effect of steam and then to the effect of compressed
air, as with defendant's process, and in figure 2 of this 700
patent Petit illustrates the carrying on of his process in connection with a blank having inturned flanges, the presence of which would tend to improve the character of the seal, as with the Messer patent. For these reasons I regard the Messer patent as disclosing but very little advance, if any, over the art as well understood at the date of its application, and at best as relating to a small detail in the process which is quite independent of any considerations in this case. The company owning the Petit patents in England is making and

701 selling celluloid records under those patents in large quantities without using the specific details suggested by Mr. Messer, so that I should hardly regard this Messer patent as disclosing "the keynote to a successful commercial process."

> BY MR. SHERIDAN: That part of the witness's answer relating to what is being done under the Petit patent in England is objected to as voluntary and as hearsay, there being no foundation in the record for the statement. 702

38 Q. In answer to Q. 24 Mr. Carter expresses the opinion, supported by some alleged experiments, that it is not practicable to make a duplicate phonographic record of wax or waxlike soap, such as complainant's Edison records are made of, by using the machines and following the process employed by defendant in the manufacture of its celluloid records. Is Mr. Carter 703 right in this matter, and do his alleged experiments support his conclusion?

A. I regard Mr. Carter's experiments as neither fair nor conclusive. As I understand him, he placed an ordinary Edison soap blank in a Lambert mold, turned on steam, presumably at a pressure of about 40 pounds, and found that the blank became immediately disintegrated. I have not verified Mr. Carter's experiment in this respect, but I accept his statements as correct, since these Edison soap blanks are slightly 704 soluble in very hot water and would undoubtedly be seriously affected by steam at a high pressure and temperature. It does not follow that because steam does not affect celluloid except to soften it, the same effect would take place in connection with all materials, and I think that no one familiar with this art would attempt Mr. Carter's experiment with any hope of getting a successful result. It would immediately occur to a person familiar with the art that since with the Lambert process the object of using the steam is to soften the celluloid, when other materials are to be employed

705 some equivalent means should be used for heating the material in a proper way. I have therefore carried on experiments with what I think may be fairly considered the Lambert process wherein soap blanks are employed but in which the softening of the material was secured by heating the mold, after which the material was mechanically expanded by means of compressed air under a pressure of about 120 pounds per square inch. The mold was heated by a water-jacket to a temperature of about 140 degrees Fahrenheit. In all 706 respects the apparatus used was that shown in the Lambert patent No. 742454 except that no provision was made for admitting steam to the interior of the blank, and a rubber gasket was used to make a tight joint at the top. I present two records made by me on April 5, 1904 under this process. These experiments convince me of the entire practicability of expanding a soap blank by means of compressed air. One of these records has just been tried on a phonograph in the presence of defendant's counsel and is an 707 excellent and entirely commercial article.

> Records produced, offered in evidence and marked "Complainant's Exhibit Lambert Process Soap Record No. 1 and No. 2".

39 Q. In answer to Qs. 25 and 26 Mr. Carter expresses the opinion that it is not possible to produce defendant's celluloid records by the process described in the Edison patent in suit, and he refers to some 708 alleged experiments in support of this opinion. Do you agree with his conclusion and do you approve of his experiments?

A. Mr. Carter, in my opinion, is not right, and I regard his experiments as entirely inconclusive. What Mr. Carter attempted to do was to introduce a Lambert blank in a mold, after which the two were placed in an oven and heated to a temperature of 300 degrees Fahrenheit. The purpose of this experiment was obviously to show that by the application of heat alone

709 a celluloid blank would not take an impression by its own expansive force. The experiment was entirely unnecessary, since no one has contended in this case that satisfactory celluloid records could be made in this way, and both Mr. Wurth and Mr. Lambert testified in the Edison-Lambert interference that it could not be done. The point, as I have frequently said, is entirely outside of any consideration in this case, because this idea of causing a blank to take an impres-
710 sion by its own expansion force is made the subject only of claims 1 and 18, which are not sued on. As an evident apology for not attempting in these particular experiments to expand the heated celluloid blank mechanically, as suggested in the patent in suit, Mr. Carter states that the presence of the end flanges on the Lambert blank would prevent the effective employment of a tapered mandrel. It is clear that if the end flanges are to be retained, some other form of expander would have to be used than a tapered man-
711 drel, for example the expansible bag shown in figure 8*a* of Lioret's British patent. This of course would be within the terms of the claims of the patent in suit and would be obvious to any mechanic. Mr. Carter also asserts that it would be impossible to make use of a tapered mandrel on account of the thinness of the wall of the Lambert blank, but in this respect he is entirely in error, since I have found it possible to make very excellent records by the exact process of the Edison patent in suit including the use of a tapered mandrel
712 and wherein I made use of blanks formed by taking commercial Lambert records and cutting off the end flanges. In these experiments the blanks were heated somewhat below 200 degrees Fahrenheit and were expanded by means of a tapered mandrel. I produce two of such records made by employing a Lambert blank, and also a third record made by employing a somewhat longer celluloid tube but of no appreciably greater thickness. These records are excellent in quality, as I have tested them on a machine. In order that I might not have to fit separate flanges to these

713 exhibit records, I mounted them on a separate wax blank so that they would fit the mandrel of the phonograph.

> Records produced offered in evidence and marked "Complainant's Exhibit Edison Process Celluloid Record No. 1, No. 2 and No. 3."

40 Q. In answer to Q. 27 Mr. Carter refers to some experiments with thick celluloid blanks in his endeavor 714 to make a celluloid record by the process of the Edison patent in suit. Do you regard these experiments as at all conclusive?

A. No sir, I do not. In these experiments Mr. Carter found it impossible to make celluloid duplicates by the use of a tapered mandrel even when the blanks were very much thicker than those used by defendant, but he admits that the experiments "were carried on under conditions which in some respects were rather crude." What he did was to build up a blank of 715 several sections, but he should have known that in doing so there would be inevitable play between the sections which would prevent the effective use of a tapered mandrel. He also admits that the blanks were quite variable in thickness and in diameter, and that they did not closely fit the matrix. An experiment carried out under these crude conditions dealing with the reproduction of impressions less than .001 of an inch in depth could hardly be expected to be successful. I have found it entirely practicable to 716 make celluloid duplicates by employing a tapered mandrel out of the exact material used by defendant, as shown by the exhibits just introduced, so that obviously there would be no difficulty in making duplicates of thicker material. Mr. Carter calls attention to the fact that it would be very difficult to make a celluloid blank of a uniform diameter or bore, and suggests the great difficulty which would be encountered if it were attempted to turn off the celluloid in a lathe. Obviously no one would think of doing this, 717 since celluloid can be readily softened in boiling water and forced over a mandrel of any desired size and shape. This, in fact, is exactly what defendant does.

41 Q. In answer to Q. 28 Mr. Carter says that neither Lioret, Young nor Edison realized that heating with steam was the only practicable method of softening the celluloid. Was this step in defendant's process a new idea in the manipulation of celluloid?

A. I cannot agree with Mr. Carter that heating with
718 steam is the only practicable way of softening celluloid for this purpose, since I have found it entirely practicable to soften celluloid by a dry heat of less than 200 degrees Fahrenheit obtained by surrounding the mold with a closed chamber containing hot water. Mr. Carter is entirely wrong if he is of the belief that there was anything novel with defendant in suggesting that steam could be used for this purpose. Ever since the invention of celluloid, it has been well recognized that it could be softened by heat preferably by a moist
719 heat such as by boiling water or steam. For instance, in Thorpe's "Dictionary of Applied Chemistry," London, Longmans, Green & Co., 1890, Vol. 1 page 450, the article on "Celluloid" says:

> "Celluloid is highly inflammable but non-explosive even under pressure; hence it may be worked under the hammer or between rollers without risk. It softens in boiling water, and may then be readily molded or pressed into
> 720 various forms."

In Appleton's American Cyclopedia (New York, D. Appleton & Co. 1883) Vol. 4, I quote from the article on "Celluloid":

> "The Messrs. Hyatt obtained another patent in 1874 for a particular method of molding celluloid, as also pyroxylin etc. Owing to the inflammable nature of the pyroxylin, a special manipulation is required. The first part of the

721

> new invention consists in subjecting the material, in porous or other suitable molds, to the direct action of steam, which not only heats and softens the mass with great facility, but, by excluding the heated air therefrom, and immersing the material in steam, diminishes to a great degree the liability to combustion, while it absorbs more or less of the volatile solvents remaining in the material. * * * For molding celluloid the temperature will range between 212 degrees and 300 degrees Fahrenheit, and consequently it requires a pressure varying from that of the atmosphere to 64 pounds above." 722

42 Q. In answer to Q. 28 Mr. Carter expresses the opinion that it remained for Messer to devise the means which formed

> " the keynote to success in this line of manufacture, the final step crossing the line from commercial failure to commercial practicability." 723

Do you agree with this view?

A. No sir, I do not agree with him, and in fact the only change made by Messer over the suggestion of the Petit patent No. 689118 of December 17, 1901 was the provision of a series of vents for permitting the escape of air from between the blank and matrix and for which Petit suggested an obvious equivalent. I do not regard this as anything more than a mere detail which hardly 724 warrants Mr. Carter's enthusiasm.

43 Q. In answer to Q. 29 Mr. Carter expresses the opinion that the Edison patent in suit contributed nothing toward the ultimately successful process of manufacturing commercial celluloid records. Do you agree with him in this?

A. I do not agree with him in this matter. His opinion is based on what I regard as an incorrect understanding of the Lioret and Young patents, as well as upon experiments to which I have previously re-

725 ferred and whose inconclusive character I have attempted to explain. He has assumed that the Young process is exactly like that practiced by defendant, that Young made use of material as thick as that used by defendant, and that with the Young process the duplicates are contracted diametrically to clear the engaging surfaces and are then removed longitudinally. Concerning the Lioret process he has assumed that with that process a mold could be made as Lioret de-
726 scribes, that with that process a sufficient diametric contraction can take place to separate the engaging surfaces and permit the phonogram to be removed directly without unscrewing it, and finally that with the Lioret process the presence of water or air between the blank and matrix could be readily prevented. Furthermore, he assumes that Edison does not describe in his patent in suit a practicable process for making celluloid duplicates, and he finally assumes that with the Lambert process it is impossible to make dupli-
727 cates of a soaplike material as with the Edison commercial duplicates. Any one seriously entertaining such views as these could hardly be expected to give a fair statement of the contribution to the art made by Mr. Edison in the patent in suit. Mr. Lambert, who at the time of testifying in the Edison-Lambert interference knew as much about the manufacture of celluloid records as probably any man in the world and who was testifying in defendant's interest, said without any qualification that the
728 Young process was entirely inoperative and that the Lioret process was even more inoperative. My own experiments fully convince me that the Edison process with a tapered mandrel is entirely practicable for making celluloid duplicates, and that the Lambert process using a fluid pressure expander is entirely practicable for making duplicates from a soaplike material. I have already indicated generally what Mr. Edison's contribution to this art was by the patent in suit, which may be thus summarized :

729

1. He was the first to suggest a process by means of which a duplicate phonograph record could be made which would be an accurate copy of an original record.

2. He was the first to suggest as a new manufacture a homogeneous integral duplicate record capable of use on a standard talking machine.

3. He was also the first to suggest a practical process for making duplicate records of celluloid.

4. He was also the first to suggest the expedient of diametrically contracting a duplicate record from a 730
matrix or mold to a sufficient extent to clear the engaging surfaces and permit it to be directly removed by a longitudinal movement, and this was the suggestion that for the first time in the art made it possible to produce duplicate records in a continuous mold.

5. He was the first to suggest a process by which a blank was expanded into engagement with the mold so as to take a surface impression without change of shape or material displacement, the blank being sufficiently thick as to form a support or body for the 731
record surface, so that it undergoes no change of shape either during the act of removing it from the matrix or subsequent to its removal from the matrix.

6. He was the first to suggest a complete process for making duplicate records that has been found peculiarly adapted for celluloid, wherein a blank sufficiently thick to maintain its shape during and after the act of removing it from the matrix is inserted in a matrix, softened by heat, expanded mechanically to take a surface impression, is then contracted dia- 732
metrically, and is finally removed by a direct longitudinal movement.

All of these contributions to the art are used in the commercial manufacture of celluloid records and are the things that made that art a successful possibility. The variations from the details suggested in the patent in suit and adopted by defendant, while perhaps cheapening the operations, do not improve the results and are, after all, merely the inevitable refinements

733 which follow all pioneer patents and which, although possibly patentable in themselves, do not carry defendant's operations outside of those contemplated by the patent in suit.

44 Q. In answer to Q. 32 Mr. Carter makes the statement that the use of the steam pressure in defendant's process is not sufficient alone to form the record, but that the subsequent air pressure is necessary. Does this fact, if true, serve to distinguish defendant's
734 process from the process of the patent in suit ?

A. I can hardly regard Mr. Carter's experiments in this respect as being conclusive of anything, because it is simply incredible that steam under pressure should not result in the taking of an impression. Apparently all that Mr. Carter did was to turn on the steam alone at the pressure which with the Lambert process is not designed to effect the expansion but merely to soften the blank, namely, about 40 pounds. In practice, the Lambert Company used compressed air at a pressure
735 of 80 pounds, and it is manifestly absurd to expect that steam at 40 pounds pressure would give the expansive effect of compressed air at 80 pounds pressure. What Mr. Carter should have done was to have used steam at a pressure of 80 pounds, and I believe that then he would have achieved success. However, the use by defendant of a separate air pressure to secure the expansion following the use of steam to make the material soft makes the defendant's process a closer approach to that suggested by Edison than if defendant
736 used steam alone to perform the two operations of softening the blank and then expanding it. In other words, the use of steam to soften the material is the equivalent of Edison's suggestion of softening the material by heat, and the expansion of the softened material by compressed air is obviously but another way of expanding it mechanically than by a tapered mandrel as suggested by Edison.

45 Q. In answer to Q. 35 Mr. Carter expresses the opinion that the Lioret and Young patents anticipate absolutely and completely in every essential particular

claims 2, 3, 4, 5, 9, 10 and 17 of the Edison patent in suit. Do you agree with this conclusion. 737

Adjourned to May 20, 1904, same time and place.

West Orange, N. J., May 20, 1904.

Met pursuant to adjournment. 738

Present, counsel as before.

Direct Examination of Frank L. Dyer continued :

A. No, I do not agree with this conclusion of Mr.
Carter. As I have before said, the claims of the patent
in suit were allowed by the Examiner after the
Young and Lioret patents had been cited by him
against Edison, Lambert and Joyce. Those patents
had been very carefully considered by the several applicants, 739
and had been distinguished by arguments
presented to the Examiner in support of the several
claims pending before him including those of the patent
in suit. As a result of this unusually careful investigation
the Examiner was convinced that these
references did not in fact anticipate the Edison invention.
In order that that invention might be fully distinguished
from Young and Lioret, the Examiner
therefore adopted the distinctions over Young which
Lambert had called to his attention, namely, that the 740
successful process should be one in which the blank is
sufficiently thick to maintain its shape during and
after the act of disengagement from the matrix, and in
order to fully distinguish from Lioret the Examiner
himself suggested the limitation to the withdrawal of
the finished duplicate by a direct longitudinal movement,
which of course presupposes a preliminary diametric
contraction sufficient to clear the engaging surfaces.

In expressing the opinion that the claims here sued

741 on are anticipated by the Young and Lioret patents, Mr. Carter assumes that these patents cover fully operative processes, and in this respect I do not agree with him, nor in fact did Mr. Lambert agree with him when he testified on the point in the Edison-Lambert interference.

Mr. Carter regards the Young patent as anticipating the claims sued on only upon the assumption that the method disclosed by Young is like that practiced by
742 defendant, and that the material used by Young is substantially as thick as that employed by defendant. Of course in these respects he is entirely in error, because I have shown that when the Young patent is carefully examined, it discloses an entirely different process from anything here involved and one which if it could be carried out would result in very weak, uncertain, imperfect and fugitive impressions. Furthermore, as I have pointed out, with the Young process the record is collapsed, whereas with the process as
743 defined in the claims under consideration the record is contracted diametrically and then withdrawn by a direct longitudinal movement. Mr. Carter finds an anticipation in the Young patent of this particular step only upon the assumption that with the Young process the record is not collapsed but is in fact contracted in the same way as suggested by Edison. His opinion on this point is evidently based on the inconclusive experiments made by him which I have shown were not carried out in accordance with the instruc-
744 tions of the Young patent, nor did his conditions comply with the conditions set forth in the Young patent.

Concerning the Lioret patent Mr. Carter merely expresses the bald opinion that this reference anticipates the terms of the claims here sued on, although in finding such anticipation in the reference he states without qualification that Lioret discloses the idea of "removing the phonogram from the mold by direct longitudinal movement". The Lioret patent distinctly says that the record is unscrewed from the mold, and

745 I have shown that it cannot be removed in any other way, although in doing this the record surface will be injured, if not destroyed.

Concerning the 17th claim, it is interesting to note
that Mr. Carter considers it as being anticipated by
both Young and Lioret, yet this claim was the issue
of the Edison-Lambert interference, and Lambert had
every opportunity afforded by the rules to show at
that time that the claim was not patentable. He did
in fact, argue, that Edison was not entitled to make 746
the claim, but on this point he was not sustained by
the Primary Examiner or by the Commissioner on
appeal, both of whom decided that the claim applied
just as effectively to the Edison process as to the
Lambert process. Therefore so far as this claim is
concerned, it is a fact that notwithstanding the Young
and Lioret patents appearing in the record of both
Edison and Lambert, the claim was considered by the
Primary Examiner, by the Examiner of Interferences,
by the Examiners in Chief, by the Assistant Commis- 747
sioner of Patents, and by the Commissioner of Patents
in person without any question being raised in the
minds of any of those tribunals as to its patent-
ability.

Since the claims which are here sued on were very
carefully considered by the Patent Office in view of
the very references that Mr. Carter regards as anti-
cipating them, and since it is perfectly evident that
his understanding of the references is incorrect, I
cannot subscribe to his views that the claims are not 748
entirely patentable and novel.

46 Q. In answer to Q. 36 Mr. Carter expresses the opinion that the defendant's record is not made of a material "sufficiently thick to maintain its shape during and after the act of disengagement from the matrix" within the meaning of this expression as employed in the Edison patent in suit. Do you agree with Mr. Carter in this matter?

A. No sir, I do not agree with him, and I have already explained that Mr. Carter evidently fails

749 to understand what this expression means. In fact, nowhere in his deposition do I find that he has attached any significance to the words "and after" which appear in this quotation. According to the understanding between the Patent Office and Mr. Edison at the time the claims here involved were allowed, the expression in question meant that the material of the blank should be thick enough to receive a surface impression and at the same time present in its
750 body a sufficient bulk of material to offer a satisfactory backing or support for the record surface so that the material should retain its shape *after the act* of disengagement from the matrix, and also that the material should be thick enough as to be capable of shrinking out of the mold without requiring collapsing, so that therefore it should retain its shape *during the act* of disengagement. I have shown from a consideration of defendant's records that the material offers a support or backing at least 40 or 50 times the depth
751 of the very deepest indentations, and possibly several hundred times the depth of many of the indentations. Defendant's records comply absolutely with all the conditions of the claims and are fully distinguished from the special conditions of the Young patent in view of which the limitation in question was introduced and which in fact had been first brought to the attention of the Patent Office by Mr. Lambert.

47 Q. Please state whether or not in your opinion the records at present made by the defendant are ma-
752 terially different from the thicker records formerly made by the defendant with respect to their embodiment of the characteristic denoted by the phrase "sufficiently thick to maintain its shape during and after the act of disengagement from the matrix"?

A. No sir. The records now made by defendant are from .040 to .050 of an inch in thickness, and for the reasons which I have previously explained and which appear on the face of the record itself such an article represents an embodiment of the characteristic denoted by the phrase which you quote. The records formerly

753 made by defendant so far as I know were about .080 of an inch in thickness and therefore obviously presented a somewhat heavier wall for the support of the record surface; but it is perfectly evident, and I think it is not denied by Mr. Carter, that if the phrase quoted is given the meaning on which the minds of the Examiner and Mr. Edison met when the claims were allowed, the material used by defendant at the present time is in fact "sufficiently thick to maintain its shape during and after the act of disengagement from the matrix". 754
Mr. Carter admits that with defendant's records they shrink out of the mold and therefore do not change their shape *during* the act of disengagement from the matrix, and since the defendant's records are not fugitive and retain their shape for an appreciable time sufficient for all practical purposes *after* the act of disengagement from the matrix, they comply with the requirement of the claims in this respect.

48 Q. Can you produce one of these thicker Lambert records? 755

A. Yes sir, I produce one of the earlier records made by the Lambert Company marked "Light Cavalry Charge, Band, H. S. 396" and containing the superscription "Lambert Co., Chicago, Pat. Mch. 20, 1900". I cut a notch in one of the end flanges in order to measure the thickness of the wall with a micrometer.

> Record produced offered in evidence and marked "Complainant's Exhibit Thick Lambert Record". 756

49 Q. In answer to Q. 37 Mr. Carter expresses the opinion that the process employed by the defendant is substantially different from that set forth and claimed in the Edison patent in suit and only similar thereto to the extent that both are identical with the prior processes of the Lioret and Young patents. Do you agree with this view?

A. No, sir, I do not, and in fact have shown that with defendant's process the blank is sufficiently thick

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to maintain its shape during and after the act of disengagement from the matrix, and that the duplicate after it has been contracted diametrically sufficient to entirely clear the surfaces is removed by a direct longitudinal movement. Both of these distinguishing characteristics are not present in the Young and Lioret patents, and were in fact introduced into the claims here in suit for the purpose of distinguishing from the processes disclosed by those references. The claims 758 are not only fully distinguished in terms from the references, but, as I have previously pointed out, the references are inoperative, in which respect Mr. Lambert agrees with me. The defendant in this case carries out the process of the patent in suit, and obviously carries out neither the process of the Young patent nor of the Lioret patent.

50 Q. In answer to Q. 38 Mr. Carter expresses the opinion that the defendant, in manufacturing its celluloid records, does not follow the process set forth in 759 the patent to Lambert No. 645920 of March 20, 1900. Do you agree with Mr. Carter in this matter?

A. No sir, I do not. Mr. Carter's opinion on this point is based entirely on the assumption that defendant at the present time does not employ a blank which is sufficiently thick to maintain its shape during and after the act of disengagement from the matrix. He admits that with the defendant's process the blank is contracted diametrically so that it obviously maintains its shape *during* the act of disen- 760 gagement, and since the blank does not change its shape *after* the act of disengagement, the present blanks used by defendant comply with the requirement of this limitation in this respect. In my previous deposition (Q. 11) I fully considered this point and reached the conclusion that defendant's present method complies absolutely with the terms of the first claim of Lambert patent No. 645920, and I see no reason to change or modify this view in any respect.

51 Q. Can you produce one of the Lambert Co. records of the thinner variety which Mr. Carter says

761 do not employ the invention of the Lambert patent of March 20, 1900 by reason of their thinness, which record bears the date of the Lambert patent of March 20, 1900?

A. Yes sir, I produce a Lambert record marked
"950, Belle of New York, Orch.", which is about .045
of an inch in thickness of wall and which contains the
imprint on its end flange "Pat'd March 20, 1900".
This record seems to be identical with those now
made by the Lambert Company, and particularly in 762
the thickness of material used, as shown, for example,
in "Complainant's Exhibit Lambert Record and Separated End Flanges", and which present records contain the mark "Pat'd July 29, 1902".

> Record produced by the witness offered in evidence and marked "Complainant's Exhibit Thin Lambert Record".

52 Q. I call your attention to re-direct questions 1 763
and 2 of the deposition of Mr. Philpot given for the
defendant February 24, 1904. Do you agree with Mr.
Philpot in his estimate of the superiority of defendant's
celluloid records over what he refers to as the complainant's wax records?

A. No sir, I do not, but on the contrary I regard
the soap records made by complainant, which are
what Mr. Philpot refers to as wax records, as being
immeasurably superior to the celluloid records made
by defendant. The metallic soap of which the Edison 764
records are made is very much smoother than celluloid,
so that the records are superior in quality to defendant's records, being substantially free from the rushing and crackling sounds which characterize all reproductions from celluloid records. Complainant's metallic soap records are much more permanent than celluloid records in the respect that the record surface does not undergo changes in character, so that the record is of the same quality at all times; on the contrary celluloid, owing to the evaporation of its solvent, constantly

765 undergoes slight changes, so that the quality of a celluloid record gradually deteriorates. It is true that the surface of a celluloid record is much harder than a metallic soap record, so that it will wear longer, but complainant's records for practical purposes do not become worn, since it is possible to secure a thousand reproductions from one of these records without showing enough wear to be noticeable in the quality of the reproduction. These records are almost wholly of a
766 musical character, having a relatively short popularity, so that a thousand reproductions would be much more than the average user would ever think of wanting. The non-breakable character of celluloid records on which Mr. Philpot lays so much stress is largely an advertising point, since in practice very few of complainant's records are broken, and the users soon accustom themselves to the proper care necessary in handling them. Metallic soap records are very much cheaper to manufacture than celluloid records because
767 the material used is much cheaper than celluloid and the manipulations followed can also be much more economically carried on. At the present time the two large companies now in the field manufacture and sell more than 50,000 metallic soap records daily, and such records as are made by complainant command a higher price than the celluloid records manufactured by defendant. The commendatory letters which Mr. Philpot quotes in his deposition are such as are received in large numbers by complainant and some of which have
768 been printed in complainant's monthly publication. It seems to be the general idea in the trade that the Edison record, taken all in all, is a very superior article.

53 Q. Have you had prepared drawings illustrating by comparative views the processes of the Lioret and Young patents and the processes of the patent in suit and of the defendant; if so, kindly produce and explain them?

A. Yes sir, I produce four sheets of drawing in which I have attempted to illustrate diagrammatically

769 the several processes which I have referred to in my testimony.

Sheet 1 shows the Edison process of the patent in suit, A being the mold and B the blank. In figure 1 a small section of the blank on a greatly enlarged scale is shown within the mold. In figure 2 the blank has been expanded outwardly so as to take an impression from the mold. It will be observed that this impression is merely a surface impression and that a great body of material exists behind it to support and maintain it. 770 In figure 3 the resulting duplicate is shown as being contracted diametrically so as to be capable of being withdrawn by a direct longitudinal movement.

On sheet 2 I illustrate defendant's operations, which it will be observed are exactly the same as those of the Edison process except that the relative thickness of the blank is somewhat less. It will be noticed, however, that the blank offers a great bulk of material behind the record surface for supporting it—at least 40 or 50 times the depth of the very deepest indentations 771 and probably several hundred times the depth of most of the indentations.

On sheet 3 I illustrate the Young process. In figure 1 the blank is introduced into the mold, which has been first warmed or slightly heated so as to make the blank pliable. In figure 2 the pliable plank is shown as pressed gently up against the record surface so as to take the impression. In figure 3 I show how the blank is collapsed in order to remove it from the matrix as described by Young. In figure 4 I show the 772 very thin duplicate record mounted on a support or backing C, the indentations in the thin blank being exaggerated. The objections to this expedient of mounting a thin shell on a separate backing have been already referred to and were clearly recognized and explained by Mr. Lambert in his first patent as well as in the prosecution thereof.

On sheet 4 I illustrate the Lioret process. In figure 1 the record appears at *a* at the bottom of the channel formed by the threads, and the blank is shown in posi-

773 tion ready to be expanded. In figure 2 the expansion has been effected and the material has been forced into this channel so as to engage the record surface at its bottom. I do not show in this figure any water bubbles or air bubbles, which in my opinion would be inevitably present to prevent this intimate engagement between the blank and the mold. In figure 3 I show the effect of longitudinal contraction tending to rip off the threads and make it very difficult to unscrew the

774 resulting duplicate, as I have explained.

Drawings referred to offered in evidence and marked respectively "Complainant's Exhibit Diagram Edison Process," "Complainant's Exhibit Diagram Defendant's Process," "Complainant's Exhibit Diagram Young Process" and "Complainant's Exhibit Diagram Lioret Process."

Complainant's counsel also offers in evidence

775 the several patents referred to by the witness which are not already in evidence, namely, United States patents of Edison 382418, 382419, 382462 of May 8, 1888, and 430278 of June 17, 1890, the same being marked "Complainant's Exhibit Edison Patent No. 382418, No. 382419, No. 382462 and No. 430278" respectively.

Also the U. S. patents of Herrington No. 397856 dated February 12, 1889, and No. 399265

776 dated March 12, 1889, and the same are marked "Complainant's Exhibit Herrington, Patent No. 397856 and No. 399265" respectively.

Also U. S. patents of Petit 689408 of December 24, 1901, 657956 of September 18, 1900, and 689118 of December 17, 1901, and the same are marked "Complainant's Exhibit Petit Patent No. 689408, No. 657956 and No. 689118" respectively.

Also figures 59, 60, 61 and 62 and the portion

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of the specification descriptive of those figures of Edison's English patent No. 1644 of 1878, and the same is marked "Complainant's Exhibit Extract Edison's English Patent 1644 of 1878."

CROSS-EXAMINATION BY MR. SHERIDAN:

54 x-Q. You speak quite positively, in answer to question 52, as to the business of complainant in this suit. 778 Will you kindly state what your exact position is with complainant that enables you to give this information?

A. All work in connection with patents and all legal matters connected with the complainant as well as of all Mr. Edison's companies are under my supervision and placed by me in the hands of such counsel as I may select By reason of this fact I am familiar with complainant's business as well as the trade conditions generally.

55 x-Q. Then you are the legal adviser of the com- 779 pany as well as the expert in this suit, are you?

A. Yes sir.

56 x-Q. Have you any financial interest in the company complainant?

A. No sir, none whatever.

57 x-Q. You were also the patent solicitor who prosecuted the Edison patent sued on as well as other Edison patents, were you not?

A. I was and am.

58 x-Q. In regard to the experiments carried on by 780 you and which you have referred to in your foregoing deposition, results of which have been offered in evidence, was defendant or anybody connected therewith, as of counsel for defendant, invited to be present at such experiments?

A. No one connected with defendant was present during the experiments you refer to, but whether invited or not I am unable to say. I should be glad to perform any of these experiments before you now or

781 at any other time that may be convenient if you wish me to do so.

59 x-Q. Long before the date of the Edison patent in suit the making of matrices by a galvanoplastic process for the reproduction of embossed or molded phonograph records was old, was it not?

A. Yes sir, the patent in suit refers to Mr. Edison's prior patent of October 18, 1892 as disclosing a suitable method of making the matrix or mold, but I am

782 not aware that prior to the application for the patent in suit any practical method had been suggested for obtaining duplicate records from a matrix or mold however perfect the latter might be.

60 x-Q. Then this making of the matrix was old and well known before the dates of the Lioret United States patent No. 528273 dated October 30, 1894 and filed December 20, 1893, was it not?

A. Yes, sir.

61 x-Q. I will ask you if the following is a good

783 and practical description of making a matrix for the reproduction of phonograph records: First to take a wax cylinder and by means of recording stylus in the usual way produce a record thereon, and this carefully coat with plumbago or other suitable material capable of rendering the said wax surface of good electrical conductivity, then suspend the same in electrical plating bath and electrically connect the said prepared surface of the record with one pole of a suitable primary, secondary or other battery and connect the

784 anode with the other pole of the battery according to the nature of the bath so as to produce a metallic deposit on said record, and provide or coat the same with a metallic surface; when sufficient deposit has been obtained, the latter is removed from the bath and exposed to a gentle heat until the wax has been melted and drained out of the hollow metallic cylinder; said cylinder is then fixed within an outer cylindrical or other shaped case of metal, or such casing may be cast around the cylindrical electro so as to provide a sufficient backing for the same?

785 A. I think so, provided the plumbago is in very finely divided condition and is applied uniformly to the original master so as to entirely coat it without filling up the indentations of the record, and provided also that a metal is selected for the electrodeposition which will deposit uniformly.

62 x-Q. And that is substantially the process which the defendant company uses to make their matrices, as you understand it, is it not?

A. Yes sir. 786

63 x-Q. And it is also substantially the process of making matrices described in the Young British patent No. 1478 of 1894 beginning with line 23 of page 3 to the end of that paragraph, is it not?

A. Yes, sir.

64 x-Q. And it was also well known in the art of
reproducing phonographic record cylinders more than
two years prior to the filing date of the Edison patent
in suit that you could take and form a metal mold by
electrodeposit upon an original phonographic cylinder, 787
then place bodily within the so obtained mould a solid
ring of plastic material capable of being softened by
heat, next softening this ring by heat, and finally so
distending the said ring within said mold by internal
pressure that it will receive therefrom an impression
corresponding with that of the original cylinder, was it
not?

A. The art of reproducing phonographic record cyl-
inders as now practiced found its inception in the
patent in suit, and that art as so understood did not 788
exist before the application for the patent in suit. It
is true that both Lioret and Young had hopes of suc-
cess, but, as Mr. Lambert pointed out and as my ex-
periments showed, these hopes were baseless. I make
this explanation because your question is broader than
the perfected art and contemplates the inoperative
process of the Lioret patent. This being so, I agree
with you that operations such as you suggest were de-
scribed more than two years prior to the filing date of
the patent in suit, but I do not admit that any opera-

789 tive process for making duplicate phonographic record cylinders was described more than two years before that application.

65 x-Q. I will read you the third claim of the Lioret U. S. Patent No. 528273 of October 30, 1894, the application for which was filed on December 20, 1893 :

> "The method of reproducing phonographic cylinders which consists in first obtaining a 790 metal mold by electro-deposit upon an original phonographic cylinder, next placing bodily within the so obtained mold a solid ring of plastic material capable of being softened by heat, next softening this ring by heat, and finally so distending the said ring within said mold by internal pressure that it will receive therefrom an impression corresponding with that of the original cylinder, substantially as herein described."

791 And ask you if this was not part of the patented art more than two years prior to the filing of the application of the Edison patent in this suit ?

A. You have of course correctly quoted the third claim of this Lioret patent, which was granted more than two years before Mr. Edison's application, but since Lioret discloses an inoperative process it was certainly no useful contribution to the art.

66 x-Q. And if this third claim of the Lioret United 792 States patent is valid, it covers and includes the process as carried on by defendant ; in other words, if this claim is valid, defendant infringes it by the use of its present process ; is that true or not ?

Objected to as immaterial and incompetent.

A. Of course I know that the claim is not valid, first because of Mr. Edison's prior invention which was brought out in the Edison-Lambert interference with which I was connected, and second because the Lioret

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process is inoperative. I therefore cannot assume
that the claim is valid.

67 x-Q. I am not asking you as to the validity of
the claim ; the Courts will in due time determine
that ; I am asking you to assume the validity of the
claim, as you are bound to do in the absence of a
judicial decision to the contrary, and then to say in
your opinion whether or no defendant's process as now
carried on by it is an infringement thereof. Please
answer categorically if you can ? 794

Same objection.

A. I cannot give an opinion on this point because
I cannot assume that the Lioret process is operative ;
but if it were operative and if it were possible to make
a duplicate record as Lioret suggests and get it out of
the mold without injuring its record surface, I should
say that the differences between such a process and
that practiced by defendant would be sufficient to dis- 795
tinguish defendant's process from the Lioret patent.
Of course this opinion amounts to nothing, because
my experiments have shown that the Lioret process is
not operative and that the duplicate cannot be re-
moved from the mold without injuring the surface.

68 x-Q. Leave out of consideration any preconceived
prejudices that your ill-advised and unsuccessful ex-
periments may have instilled in your mind as to the
inoperativeness of this process, and confine your
answer to the claim and to the question as asked. 796
The question is again repeated and a responsive
answer to the question is respectfully asked.

Complainant's counsel objects to the question as immaterial, and suggests that the witness is incompetent to say what limitations the Court might put upon the claim of the Lioret patent in order to sustain it in view of the prior work of Edison and in view of the peculiarities of the Lioret process even if operative.

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By Mr. Sheridan: Defendant's counsel respectfully suggests that the witness has not found any difficulty in removing or placing limitations on the patent sued on in view of the fact that that is generally considered to be the province of the Court, and sees no reason why this objection of complainant's counsel should be taken at this time as to this earlier Lioret patent, and repeats the question.

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A. I have no prejudices at all in this case either for or against the Lioret process. I had supposed that for years the inoperativeness of this patent had been generally recognized. Certainly Mr. Lambert, who was more familiar with the manufacture of celluloid records than anybody who has so far appeared in this case, had no hesitancy in expressing a positive opinion on the point, and at that time was testifying for defendant's interest and against Mr. Edison. The experi-
799 ments which I made with the Lioret process were not ill-advised, because if an experiment can be made a success the Edison laboratory affords the best opportunities in the world for carrying it out. When I undertook these experiments I had no other purpose in mind than to carry out the exact language of the Lioret patent, but I found that that was entirely hopeless and tried all sorts of ways to make it work, even going so far as to drop the idea of a steel master entirely and using a wax master. I found that the
800 Lioret process is absolutely inoperative in principle as well as in details, so that my experiments confirmed Mr. Lambert's opinion. Of course claims of a patent are not looked upon as a mere collection of words, and it is simply impossible for me to make your assumptions and express an opinion that would serve in any way to guide the Court on this question.

69 x-Q. Then you confess that you cannot dissassociate the language of the claim from your experiments, and that you are incapable of expressing an opinion as

801 to whether or no defendant's process comes within the terms of this third claim of the Lioret patent?

Same objection.

A. I have no settled conviction on this point other than that based on my knowledge of the inoperativeness of the Lioret patent. I previously suggested that if the Lioret patent was operative and valid, it was probable that the process as practiced by defendant, 802 owing to the differences between the two and the different character of products obtained, might not comply with the language of the third claim of the Lioret patent if properly construed to cover the Lioret invention.

70 x-Q. As I understand you, your objection to the Lioret patent and the claim of which we have been talking is founded on the fact that you deem the process, either taken partially or as a whole, inoperative, in that Lioret did not, according to your light, 803 disclose a practical method of making a matrix and a practical method of separating the finished product from the matrix; is that true or not?

A. Yes, and for the additional criticisms which I have applied to the Lioret process.

71 x-Q. Briefly state your additional criticisms.

A. First, with the Lioret process it would be impossible to exclude water from the space between the blank and mold, and consequently it would be impossible to cause the blank to intimately engage the 804 mold at all points. Second, since the record itself is located at the botton of a relatively deep channel, the material has to be displaced to a correspondingly great extent, and it would be much more difficult and perhaps impossible to get as accurate an impression this way as from a record whose maximum depth is less than .001 of an inch and in taking which the material has to yield to a corrospondingly slight extent.

72 x-Q. Was the patent in suit the first publication

805 or patent to teach the public how the moisture and air of your first objection could be eliminated?

A. Practically, yes, as far as I know. Perhaps with the Young process there might not be so much difficulty in this respect, since with the Young process the water is left out and the very thin blank is heated from the warmed mold. At the same time a very thin blank such as Young describes would be much more likely to trap air, since its surface is more or less pliable, than
806 would a blank of the thickness contemplated by the
patent in suit.

73 x-Q. And you consider that this first objection was a very serious objection, which the inventors had to overcome before designing a perfect practical process for reproducing phonographic records, do you?

A. By "first objection" I presume that you mean the trapping of the water or air which I have referred to as one of the objections incident to the Lioret process although not necessarily an objection in the prin-
807 ciple involved. This trapping of air or water would,
in my opinion, be a practical objection which would have to be cured before the Lioret process could be carried on even if not inoperative in principle.

74 x-Q. And it is for these reasons that you think the Lioret patent should not be given any force or effect; is that true?

A. In my opinion the Lioret patent has no bearing on the patent in suit, first because it is inoperative for the several reasons stated, and second because it is a
808 different process for the reasons also stated and which
were recognized by the Patent Office when the claims for the patent in suit were granted.

75 x-Q. Is it not true as a condition precedent to obtaining a patent that it is only necessary to disclose the invention or subject-matter thereof with sufficient precision *to enable those skilled in the art* to practice the same?

A. Yes, and the more common the art becomes, the less precision is required.

76 x-Q. The statute and rules only require that at

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the end of the specification you should point out that which you consider to be new and which in modern practice means the paragraphs called " claims " of the patent ; is not that true ?

A. Section 4888 of the Revised Statutes provides that the inventor

> " shall file in the Patent Office a written description of the same (his invention or discovery) and of the manner and process of making, con- 810 structing, compounding and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound and use the same * * * and he shall particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery."

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77 x-Q. And the United States Patent Office on the 30th day of October, 1894, after due and lawful proceedings had been had by its officers, did grant unto H. J. Lioret Letters Patent of the United States No. 528273—a patent covering (see claim 3)

> " The method of reproducing phonographic cylinders which consists in first obtaining a metal mold by electro-deposit upon an original phonographic cylinder, next placing bodily within the so obtained mold a solid ring of 812 plastic material capable of being softened by heat, next softening this ring by heat, and finally so distending the said ring within said mold by internal pressure that it will receive therefrom an impression corresponding with that of the original cylinder, substantially as herein described."

thus putting the stamp of approval upon all of his actions : *first,* that he had complied with the statutory

813 requirements; *second*, that his method was fully operative; *third*, that he had described it with sufficient precision to enable those skilled in the art to make or practice his invention; and *fourth*, that he had pointed out clearly at the end of the specification that which he considered to be new. Is that true or not?

A. Of my own knowledge I do not know whether the proceedings connected with the grant of this patent were the usual proceedings or that the patent was 814 lawfully issued. It is a fact that Lioret did obtain the patent to which you refer which was cited against the Edison application and also against the Lambert case and with which everybody was perfectly familiar. This patent relates to a phonograph, and the only part which has to do with the present case is the brief matter found in the second column of the second page and covered in the third claim; all the rest of the patent and the remaining four claims relate to other matters.

815 78 x-Q. And at the date of the Lioret patent it was well known in this particular art that you could make a perfectly satisfactory matrix by the galvanoplastic method. Is that true or not?

A. Yes sir. As I said, Mr. Edison disclosed the manner of making the matrix or mold in his split mold patent of 1892.

79 x-Q. Now taking the perfectly satisfactory matrix either split or solid, and taking and practicing this part of the Lioret process,

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> " placing bodily within the so obtained mold a solid ring of plastic material capable of being softened by heat, next softening this ring by heat, and finally so distending the said ring within said mold by internal pressure that it will receive therefrom an impression corresponding with that of the original cylinder",

would you not have a perfectly practical process for reproducing celluloid or other records, leaving out of

817 consideration the removal of the completed phonographic record from the matrix?

A. As I understand your question you want to know if, instead of using the particular kind of a master record described by Lioret and the particular kind of a mold or matrix obtained by him, we use a different kind of a matrix or mold obtained from a different kind of master and place within this matrix or mold a blank cylinder which, instead of being expanded as described by Lioret so as to be materially displaced and 818 engage a relatively remote record surface, is caused merely to take a surface impression against the surface of a mold whose greatest depth of indentation is less than .001 of an inch, whether such process would be a practical one; and to this I reply that it would not, because your question does not contemplate the exclusion of water and air from between the blank and the mold.

80 x-Q. Please point out in the patent sued on all reference to moisture and air in the production of 819 celluloid or other records, and also where the patent in suit points out how this specific objection can be overcome?

A. The specific objection is not present in a process in which no opportunity is offered for the entrance of water between the blank and mold and in which a relatively thick blank is expanded uniformly so as to drive the air out from between the surfaces. The process of the patent in suit, even to its specific details, is a fully operative process which has been practically 820 carried out commercially.

81 x-Q. Is it not a fact that the Messer patent No. 705772 of July 29, 1902 is the first patent to recognize this objectionable feature of trapping steam, moisture and air, and the first patent, so far as you are aware of its commercial reduction to practice, that provides for the elemination of this objectionable feature? I call your attention to the matter on page 2 of the Messer patent beginning at line 46 with the

821 words "When steam" etc. down to the end of the paragraph on line 121 of the same page.

A. No sir. Any practical process for making duplicates must provide for the escape of air (or moisture if it is used), and in any process using a relatively thick blank, as suggested in the patent in suit, and not using hot water in which the mold and blank are immersed as suggested by Lioret, the air will naturally escape. Thus in Lambert's patent No. 742454 of
822 October 27, 1903 (application filed June 14, 1900), it is stated:

> "The natural irregularities of the adjacent surfaces of the matrix and base thus afford a sufficient opening between the lower end of the matrix and base to permit air to escape from between the record cylinder and matrix".

Another example of this practice is found in the
823 patent to Petit No. 689118 dated December 17, 1901, in which air from between the blank and matrix would escape into the space in which the packing 5 is located. Of course any practical process must provide for the intimate engagement of the blank with the matrix, and any process that does not provide for the elimination of any foreign fluid or liquid between the two will be impracticable.

82 x-Q. Then according to your answer it was not the patent in suit that first publicly gave knowledge
824 of this objectionable feature in unmistakable language and which showed how a process in which this objectionable feature was likely to occur could be carried on and such feature eliminated?

A. Your question is not clear, but as I understand it, the patent in suit was the first disclosure of a practical process for making duplicates of celluloid or other material and, being a practical process, it provided for the intimate engagement of the blank with the matrix surface and therefor necessarily excluded any foreign liquid or fluid between those surfaces. The patent in suit states that "the blank will be further expanded mechanically into absolute intimacy with the record" (page 2 lines 49–51), thereby necessarily including the simultaneous expulsion of the air from between the surfaces.

83 x-Q. Does not the Lioret patent state (page 2 beginning at line 100):

> "The celluloid is thus softened, and I then introduce forcibly into the said collar or ring *c* a mandrel a^2 sufficiently large to dilate the said ring or collar and cause it to penetrate into all the cavities of the mold a^1"?

A. Yes sir, although I do not agree with the correctness of this statement.

84 x-Q. You are positive, are you, that a threaded cylindrical celluloid or other phonographic record cannot be made in accordance with the general principles disclosed in the Lioret patent and removed from the matrix without damaging or injuring the phonographic record—I mean removed from a solid matrix and by direct longitudinal instead of helical movement?

A. Yes sir, I am convinced of the inoperativeness of the Lioret patent and the impossibility of making a duplicate celluloid record after the process described therein without injury, if not destruction, to the record surface.

85 x-Q. Time and again in your direct examination you have stated substantially that even if a satisfactory mold could be made having threads therein and you were to force into such threaded matrix a celluloid record, it could not be removed therefrom without doing violence or injury to the sound record thereon. Is that not true?

A. That is my belief.

86 x-Q. I hand you a threaded celluloid record and a matrix from which you can take my word it was made (or not as you prefer) and in which the completed record has been placed and carried for a thousand

829 miles or more, and ask you whether you think such record could be made in such a matrix and removed therefrom or not?

A. I have examined the record and the mold which
you hand me under the microscope, and find that it ap-
pears to be formed with an excessively shallow thread
about $\frac{1}{40}$ of an inch wide at its base and about .001 of
an inch in height, because I note that on the mold
many of the projections which correspond to the de-
830 pressions in the record are substantially as high as the
thread, or in other words, the recorder in forming the
record substantially cut down through the entire thread.
It is possible that with a mold of this character a
duplicate record might be contracted diametrically and
removed longitudinally, but I have never verified the
experiment and cannot say it of my own knowledge.
So far as I can see, the record and mold which you
hand me represent a mere *tour de force*, since there
would be no advantage whatever in cutting these very
831 shallow threads on the record, and there is the very
great disadvantage that a duplicate made in this way
could not be used effectively on standard talking ma-
chines.

87 x-Q. Your objection to the British patent to Young No. 1478 of 1894 is that it is your opinion that in order to remove the completed plastic cylindrical phonographic record, it must be collapsed; is that true?

A. That is one of my objections, and that is exactly
832 what the patent says.

88 x-Q. It is a well known natural phenomenon that with few exceptions all materials expand when heated and contract when cooled or deprived of heat, is it not?

A. That is generally true, unless of course there are opposing forces counteracting the molecular changes.

89 x-Q. I am asking a general question and would like to know whether it is true or not?

A. Yes, generally speaking.

90 x-Q. Is there any reason to believe that this

833 natural phenomenon would be suspended in the practicing of the processes of either the Lioret or Young patents?

A. In connection with the Lioret process the very contraction which the finished duplicate is subject to makes it very difficult to get it out of the mold and results in damage to the record surface. In the Young process, however, two things are to be borne in mind: *first*, that normally the blank is slightly larger than the bore of the matrix, so that even when the two are 834 fully cooled there would be no tendency to a separation; *second*, dealing with a very thin material which has been first made pliable by heat and then pressed into intimate engagment with the matrix, it is probable that the atmospheric pressure would be enough to overcome the contractive tendency exerted within the minute body of material; at any rate, Young states that he does collapse his duplicates, this fact was recognized in the Patent Office, and no statement to the contrary appears in the patent. 835

91 x-Q. Then we are to take it, after reading your entire deposition, that natural laws generally obey the intent of the designer no matter in what form he harnesses them, and not the laws of the Maker or Controller of the universe?

A. I hardly think you are serious in this question. Sometimes when operations are witnessed very superficially the full significance of the phenomena involved may not be appreciated, but when anything is fully understood it is generally not difficult to find confirma- 836 tion therein of some well recognized natural law.

92 x-Q. Then please tell me how anybody practicing the Young process could prevent the diametrical shrinkage of the record during the process of cooling the same?

A. For the reasons which I have stated: *first*, that with the Young process we are dealing with a very thin material which of itself presents a very small body or mass and consequently is able to exert a very slight contractive tendency; *second*, because with the

837 Young process we are dealing with very low temperatures since the patent states that the matrix is merely warmed or slightly heated, and that the thin shell is made pliable by the gentle heat which is given off from the matrix; *third*, because dealing with very low temperatures we naturally encounter but a slight reduction in temperature, so that the contractive tendency, if it could be exerted, would be very slight; *fourth*, because with the Young process the blank is
838 normally slightly larger than the bore of the matrix, so that when the blank is entirely cooled it would still be jammed tightly in position; *fifth*, because owing to the very slight mass which such a body presents, it is probable that the atmospheric pressure would be sufficient to overcome any contractive tendency, so as to hold the blank in firm engagement with the mold. Whatever may have been the reason for the phenomenon presented, it is a fact which Young makes perfectly clear that in removing his duplicates he did in
839 fact collapse them and to this extent change their shape. Another reason which convinces me that Young removed his duplicates in this way is that he probably did not recognize the possibility of shrinking a duplicate out of the mold, because he describes the operation of melting out the original master from the matrix. At the present time it is only necessary to apply cold to shrink these masters out, and the masters can then be saved. This is done by both defendant and complainant herein.

840 93 x-Q. And all of your conclusions in regard to the Young process which you have stated in your last answer are academic, are they not?

A. No, sir. What I have stated concerning the Young patent is founded on the face of the patent itself as well as upon the expression of Mr. Lambert's opinion, who said that he had tried to make records in accordance with the Young patent but without success, and when Mr. Lambert made this statement he was testifying in defendant's interest.

94 x-Q. Well let us put it another way: You are

841 simply founding your conclusions on hearsay; is that true?

A. No sir, because during the Edison-Lambert interference very thin records or portions of very thin records were presented by Mr. Lambert and which I examined, from which it appeared that the impressions were as he had said—faint, indistinct and fugitive.

95 x-Q. Did you witness the demonstrations of Mr. Carter and the results produced by him which he stated were made in accordance with the principles of the 842 Young patent?

A. No sir, I did not.

96 x-Q. Have you ever made any such experiments or demonstrations yourself?

A. I tried to expand a very thin blank in a matrix by compressed air, but was unable to get any impression at all, as there was not enough body of material to make a seal, and I therefore regarded the experiment as being entirely inconclusive.

97 x-Q. Generally speaking, your experiments 843 which were favorable to the patent in suit were always successful, but those which might cast any reflections on its validity were unsuccessful; isn't that true?

A. It is not, and I am perfectly willing, as I said before, to reproduce any experiments which counsel wishes to have made, or to give him or anybody else that he may mention the full use of the Edison laboratory for making such experiments.

98 x-Q. Defendant made a lot of experiments at 844 which complainant was invited to attend and was represented and I think they stand for themselves, as contradistinguished from experiments which you made and to which neither defendant nor defendant's counsel was invited or was present, and I will ask you, therefore, to point out what experiments you made which might in any way reflect on the patent in suit that were successful?

A. I have made no experiments whatever that in any way reflect on the patent in suit. If you have any

845 doubt as to the correctness of my experiments or as to the deductions which I have drawn from them, I shall be very glad indeed to reproduce them for you. I believe, however, that no one can possibly question the entire correctness and the conclusive character of all of my experiments.

99 x-Q. Well we will let them speak for themselves, as well as Mr. Carter's, and let the Court draw its conclusion. You insist, do you not, that Young must be

846 limited to a record which must or shall collapse during its withdrawal from the matrix ?

A. That is what Young describes and nothing else.

100 x-Q. You also insist that Lioret in his United States patent must be limited to a process in which a helical matrix is used and in which a helical disengaging action occurs, do you not ?

A. That is exactly what he describes.

101 x-Q. You also insist that neither one of these patents, although they are earlier in date than the Edi-

847 son patent in suit, is entitled to the broad general principle of the doctrine of equivalents ?

A. I make no such allegation, and will correct you in your statement that these patents antedate Edison's invention. You have evidently forgotten the fact that in the Edison-Lambert interference Mr. Edison successfully carried his date of invention back to October 1888, which was accorded him by all the tribunals of the Patent Office.

102 x-Q. You have also evidently forgotten the fact

848 that there is a statutory bar to carrying the invention back of a patent which is two years older than the filing date of the patent in suit, have you not ?

A. Hardly.

103 x-Q. It is your opinion, however, that this later Edison patent which is in this suit is not in any way limited to the specific process disclosed therein, but that it is entitled to the beneficent doctrine of equivalents ; is not that true ?

A. The patent in suit, in my opinion, represents the first disclosure of a practical process for making dupli-

849
cate records of celluloid or other material and stands
at the foundation of the art. It represents the first instance
of a process in which a duplicate record sufficiently
thick to maintain its shape during and after
the act of disengagement is removed from a continuous
mold by a diametric shrinkage followed by a
direct longitudinal removal. As to what the patent
covers is very clearly embraced in the claims and
will be apparent from a consideration of the prosecution
of the application therefor, from which it 850
will be seen just what the Patent Office was willing
to grant Mr. Edison for the purpose of covering his
process.

104 x-Q. When did Mr. Edison or his successors or anybody under his authority place records on the market which had been made commercially by the process of the patent in suit?

A. Duplicate records made by the process of the
patent in suit were first used commercially I think
about 1898, being employed as masters from which to 851
make duplicates by a mechanical duplicating process,
as referred to by Mr. Edison in the testimony given by
him in the Edison-Lambert interference. Duplicate
phonograph records made under a process which is included
by the patent in suit were first sold commercially
about February 1, 1902.

105 x-Q. Please state, in as brief a space as you can, the process which complainant is now using in the reproduction of its records for the public market?

A. At the present time complainant is using a process 852
in which the metallic soap mixture is maintained in
a molten condition at a temperature a few degrees
above its congealing point. A cold mold is then immersed
in this mixture, and by reason of its lower
temperature a considerable layer of the metallic soap
congeals on the inner surface of the mold. The mold
is then removed and the congealed mass, which quickly
solidifies, is finished on its interior. The mold with
the duplicate therein is then put over a cooling core
through which water circulates, so that the duplicate

853 will be chilled and caused to contract diametrically to clear the engaging surfaces. After this contraction the duplicate is removed longitudinally, and is then finished on its ends ready for the market. Duplicates to the number of many thousand daily are made by this process.

106 x-Q. Have you or Mr. Edison obtained a patent on this process, and if so, kindly state the number and date?

854 A. The specific process which I have described is covered and specifically claimed in patent to Miller and Aylsworth No. 683,615 dated October 1, 1901.

107 x-Q. Is this an analogous process to the one patented in the patent in suit?

A. Yes, to the extent that it embodies the invention defined in the second and third claims of the patent in suit, which covers broadly the formation of a record in any way and its subsequent removal by a diametric contraction and a direct longitudinal withdrawal. As

855 I stated, these claims were involved in interference with an application of Joyce which described a casting process in which molten material was introduced into the mold around a core and then allowed to set or harden.

108 x-Q. Is not the process described in the Edison patent 667,662 of February 5, 1901, also an analogous process?

A. Yes, sir; the second and fourth claims of this patent also cover the process which complainant uses

856 commercially, these claims covering broadly a process in which a molten material is introduced into the mold and after being allowed to set is contracted diametrically and then removed by a direct longitudinal movement.

109 x-Q. When did you abandon the specific process set forth in the patent in suit for the process which you now carry on?

A. I am unable to say when the manufacture of mechanical duplicates was entirely given up, but I believe it was sometime subsequent to the introduction

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of the Edison molded duplicates on February 1, 1902. As I said before, the specific process of the patent in suit was used for making masters for this mechanical duplicating process, so that the process was carried on commercially up to the time of the abandonment of mechanical duplicates.

110 x-Q. How long after February 1, 1902, did this occur—six months, a year, or how long?

A. My best recollection is that it was on July 1,
1902, that the manufacture of mechanical duplicates 858
was given up.

111 x-Q. Did the complainant Mr. Edison, or any of the complainant's predecessors, ever make and market celluloid records in accordance with what you understand to be the terms of the patent in suit, or did it ever make and market any celluloid cylindrical phonographic records?

A. Not that I know of.

By Mr. Sheridan: Defendant's counsel asks 859
the notary to mark this threaded matrix and
record, which is already marked "Screw No.
34704," for purposes of identification.

Signature and certificate waived.

Complainant's counsel, in view of the attitude
of defendant's counsel on the cross-examination
of this witness, offers to have the witness repeat
the experiments about which he has testified in
the presence of defendant's counsel, beginning
at the present moment and continuing until the 860
experiments are finished, and also offers to present the witness for further cross-examination after the experiments have been made in the presence of defendant's counsel.

Counsel for complainants here offers in evidence the copy of the deposition of Frank L. Dyer taken in the suit of National Phonograph

861 Company vs. Lambert Company annexed to the stipulation herein dated June 11, 1910, and the same is marked, in this cause, "Complainant's Exhibit Dyer Deposition"; and also offers in evidence the following exhibits (and such exhibits only) referred to in the said Dyer deposition, namely:

Complainant's Exhibit Diagram Edison Process.
862 " " Diagram of Defendant's Process.
" " Diagram of Young Process.
" " Diagram of Lioret Process.
" " Edison Patent No. 382,418.
" " Edison Patent No. 382,419.
863 " " Edison Patent No. 382,462.
" " Edison Patent No. 430,278.
" " Herrington Patent No. 397,856.
" " Herrington Patent No. 299,265.
" " Pettit Patent No. 689,408.
864 " " Pettit Patent No. 657,956.
" " Pettit Patent No. 689,118.
" " Extract English Patent, No. 1644 of 1878.
" " Lioret No. 2.
" " " " 4.
" " " " 5.
" " " " 6.

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Complainant's Exhibit Lambert Record and Separated End Flanges.
" " Lambert Process Soap Record No. 1 and No. 2.
" " Edison Process Celluloid Record No. 1, No. 2 and No. 3.
" " Thick Lambert Record. 866
" " Thin Lambert Record.

and each of said Exhibits is entitled in this cause and marked as marked in said Lambert suit.

(Mem. Complts.' Exhibit Lioret No. 1 and Complainants' Exhibit Lioret No. 3 cannot be found among the records of the Lambert suit and are consequently not offered.)

Counsel for Complainants also offers in evidence copies of the following patents referred 867 to in the said stipulated deposition of said Dyer, namely:

U. S. Patent to Edison, No. 200,521, and the same is marked " Complainants' Exhibit Edison Patent No. 200,521."

U. S. Patent to Lambert, No. 484,582, and the same is marked " Complainants' Exhibit Lambert Patent No. 484,582."

U. S. Patent to Lambert, No. 742,454, and the same is marked " Complainants' Exhibit Lambert Patent No. 742,454." 868

U. S. Patent to Miller & Aylsworth, No. 683,615, and the same is marked " Complainants' Exhibit Miller & Aylsworth Patent No. 683,615."

U. S. Patent to Edison, No. 667,662, and the same is marked " Complainants' Exhibit Edison Patent No. 667,662."

Counsel for Complainants also offers in evi-

869 dence a copy of the following patent referred to in the deposition of Arthur S. Brown, namely:

U. S. Patent to Frank L. Capps, No. 666,493, dated January 22, 1901, and the same is marked "Complainants' Exhibit Capps Patent No. 666,493."

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the testimony and exhibits offered in this
870 cause by the respective parties may be given to and remain in the custody of the counsel of the party offering the same to be by him returned to Court before the day of hearing.

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Complainant's Exhibit Extract English Patent No. 1644 of 1878.

British Patent
No 1644 of 1878

Fig. 59. 874

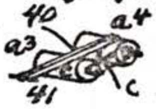


Fig. 60.

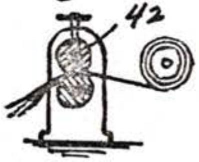


Fig 61.

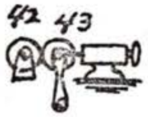
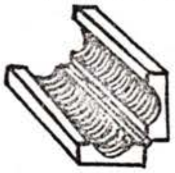


Fig. 62.



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(p. 10)

"Figure 59 shows a reindenting device for amplifying or increasing the size of the indentations. There are two rollers, one of which $a4$ travels faster than the other $a3$, and there is a lever 40 pivoted at 41, and provided with a point c for each cylinder. One point follows the indentations in the cylinder $a3$, and the other rests upon $a4$, and as this travels the fastest, the indentations made therein will be longer and also 876 deeper by the point being at the outer end of the lever. In figure 60, one roller 42 of the pair is made of hardened metal with the sound record in relief. This is obtained by electrotype or other process from an iron foil or other metal phonogram, and this roller is used to indent the strips or sheets of foil or rollers to produce copies that can be used with the phonet. Figure 61 represents a roller 42 of hardened metal with the record in relief, and arranged so as to knurl or indent the phonogram in a roller 43 of soft metal

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that is to be pressed against the roller 42 by a screw or other suitable means. The cylinder having a spiral groove in its surface may be made by placing the mold shown in figure 62 around a cylinder or shaft, and filling the space between the cylinder and mold with plaster of Paris or other suitable material. The mold is of metal with a screw or spiral rib projecting therefrom, and it is made in two parts and hinged so that it can easily be removed when the plaster of Paris 878 is dry."

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No. 713,209. Patented Nov. 11, 1902.

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

(Application filed Mar. 5, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1a

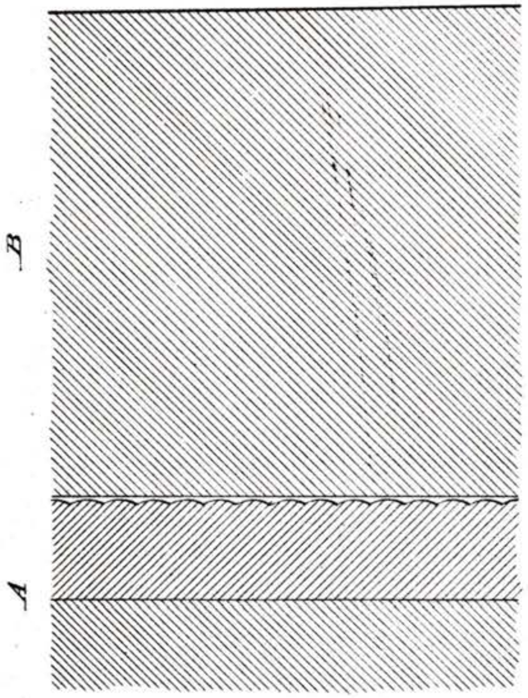
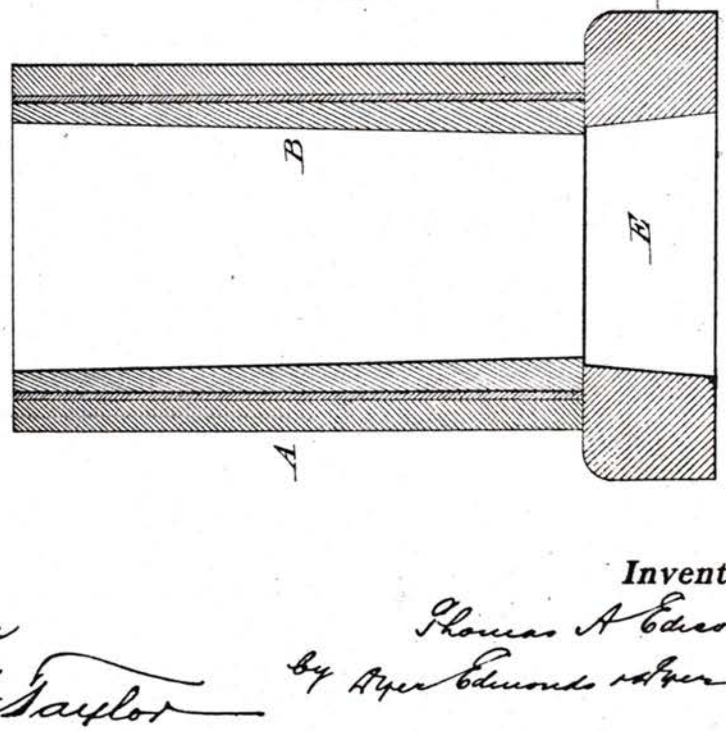


Fig. 1



Witnesses:
Jas. F. Coleman
Jno. Robt Taylor

Inventor
Thomas A Edison
by Dyer Edmonds & Dyer
Att'ys.

No. 713,209. Patented Nov. 11, 1902.

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

(Application filed Mar. 5, 1898.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 2a

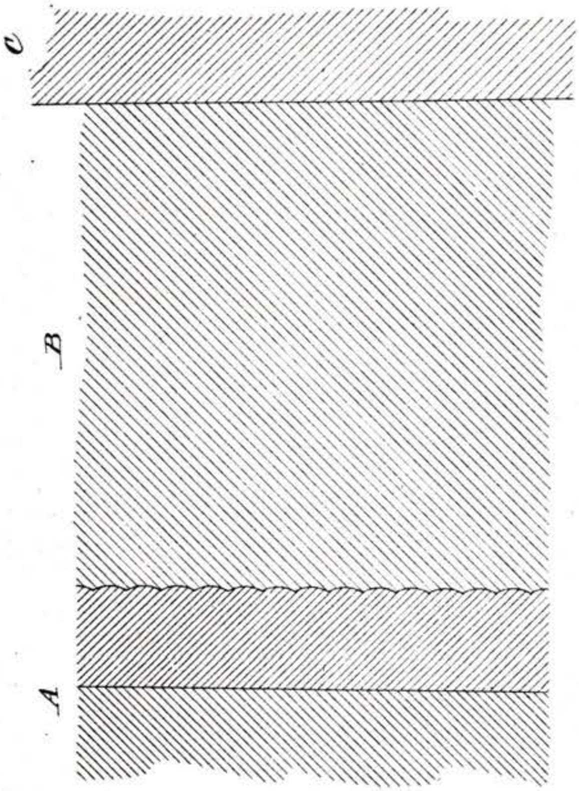
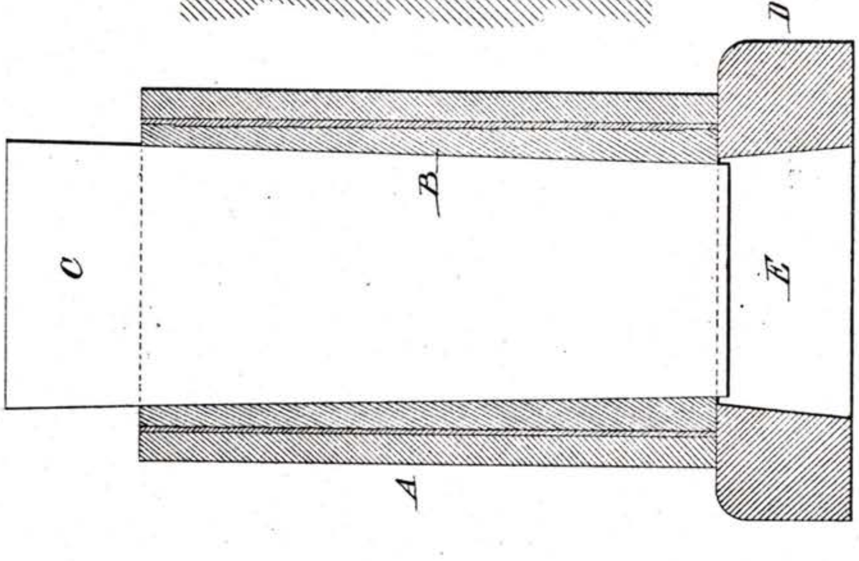


Fig. 2



Witnesses:

Jas. F. Coleman
Jno. Robt Taylor

Inventor

Thomas A Edison
by Dyer Edmonds & Dyer
Att'ys.

No. 713,209. Patented Nov. 11, 1902.

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

(Application filed Mar. 5, 1898.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 3a

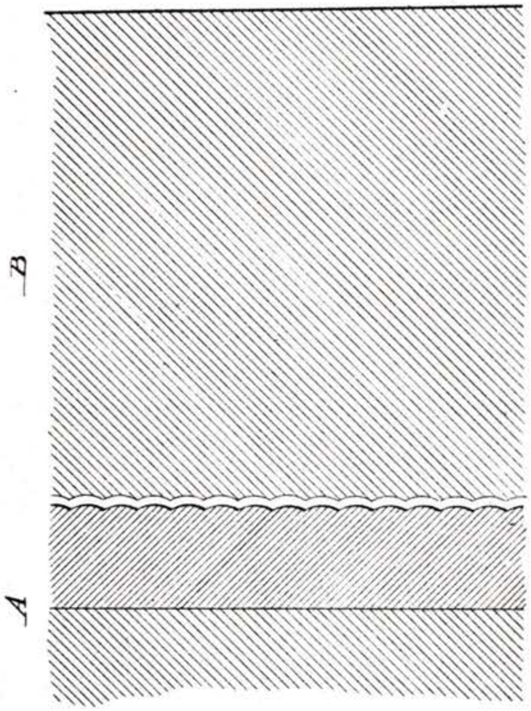
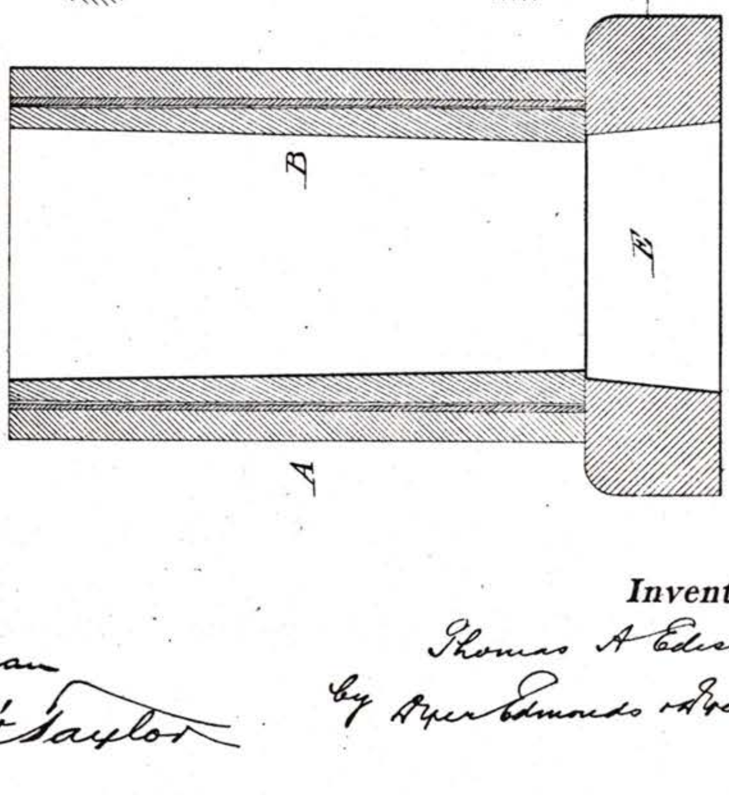


Fig. 3



Witnesses:

Jas. F. Coleman

Jno. Robt Taylor

Inventor

Thomas A Edison

by Dyer Edmonds & Dyer

Att'ys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 713,209, dated November 11, 1902.

Application filed March 5, 1898. Serial No. 672,650. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes of Duplicating Phonograms, (Case No. 994,) of which the following is a specification.

The object I have in view is to produce a practical process for the duplication of phonographic records, whereby a practically unlimited number of duplicate phonographic records may be obtained which will be absolutely identical in every respect with the original record. Generally I propose to construct a suitable matrix, preferably in metal, and by its use to impress duplicate phonograms with a phonographic record thereon, such phonograms being preferably constructed of a material having a greater coefficient of expansion than the material of the matrix or mold.

By my process the duplicate phonogram or the surface thereof may be and preferably is constructed of a material too hard for the satisfactory cutting of an original record therein by the usual phonographic recorder, whereby the duplicate phonograms may be made more durable than it is possible to make original records; but the duplicate phonograms may obviously be made of a softer material.

My improved process can be carried out for the reproduction of phonographic records of any desired form, either flat disks or hollow cylinders; but it has been specially devised for use in connection with the duplication of records of the latter type. For the duplication of cylindrical phonographic records from a tubular matrix my improved process also provides for the effective removal of the finished duplicate from the matrix without injury to the record-surface of the former.

In carrying my process into effect I first construct a matrix carrying a negative representation of the record, which matrix can be produced by any of the known processes—as, for example, those indicated in my Patent No. 484,582, dated October 18, 1892. As I explained in this patent, an original phonographic record having a surface of the usual wax-like material is first secured and its surface coated with a coating of conducting material in order to permit the original record to be electroplated. This conducting coating can be and preferably is applied by a process of vacuous deposit, as I described in my Patent No. 527,147, dated September 18, 1894, by placing the record in a vacuum-chamber in which a metal is vaporized by an electric arc produced between electrodes of the metal, the metallic vapor depositing as a thin uniform coating on the original record. I prefer to apply a preliminary coating by a process of vacuous deposit, for the reason that the highly-comminuted condition of the vaporized metal permits the coating to form as a uniform film, following accurately all the variations of the record, however minute. Instead of coating the original record with a vaporized metal it may be coated with a very thin layer of specially-prepared plumbago of exceedingly-great fineness, or instead thereof gold-leaf or silver salts reduced by chemical reagents to the metallic state may be used for the same purpose. Having thus applied a very thin preliminary coating to the original record, the latter is immersed in an electroplating bath and electroplated with a metal to the desired thickness, thereby forming a shell inclosing the original record, which shell carries on its bore an accurate negative representation of that record. Preferably this shell is suitably incased in a close-fitting cylindrical jacket, although if the electroplating is carried on long enough to form an electroplated coating of sufficient thickness a jacket need not be used. The original record is removed from the electroplated matrix obtained as described either before or after the jacket, if used, is applied to the shell. This removal of the original record can be effected either by dissolving or melting the wax-like material or by contracting the original record radially and removing it by a direct longitudinal movement. In the case of cylindrical phonographic records the resulting matrix will be a hollow metal cylinder or tube or one internally faced with metal carrying the phonographic record in relief upon its inner surface.

While I have indicated convenient and well-known methods for producing the ma-

Raymond R. Wile Research Library

trix, it will be obvious that the matrix can be obtained in any other way familiar to those skilled in the art.

Having obtained a suitable matrix carrying a negative representation of the original phonographic record to be duplicated, I proceed with the duplication of the records as follows: The blanks which are to receive the duplicate records are preferably composed of a material having a higher coefficient of expansion than that of the matrix or mold, and said blanks are made sufficiently thick to maintain their shape during and after the act of disengagement from the matrix, as will be explained. The blank under normal temperatures is of a diameter very slightly less than the bore of the matrix or mold, whereby the blank may be inserted in the same. After the blank has been thus placed within the matrix or mold both the matrix and the blank contained therein are, or the blank alone is, brought to a higher temperature, whereby the blank will expand and will be brought into intimate contact with the record-surface of the matrix or mold, whereby the negative record thereof will be impressed with absolute accuracy upon the surface of the blank. The expansion of the blank into this intimate engagement with the interior of the matrix or mold may be effected in any suitable way, such as by maintaining the matrix or mold, with the blank contained therein, in a heated atmosphere. By making the blank of a material having a higher coefficient of expansion than the matrix or mold the blank will be properly expanded to receive the impression of the record, notwithstanding the fact that both the blank and the matrix or mold may be subjected to the same temperature.

In order to facilitate the operation and make the resulting duplicate record somewhat sharper, I prefer to introduce a tapering mandrel within the blank after the blank has been placed in the matrix or mold and heat applied to the blank, as explained, and to force the mandrel tightly within the blank after the latter has been expanded into engagement with the record, whereby the blank will be further expanded mechanically into absolute intimacy with the record, after which the mandrel will be immediately withdrawn. With blanks made of sufficiently viscous material the entire expansion may be effected mechanically by forcing a tapering mandrel within the same.

After the blank has been expanded, so as to receive the impression of the matrix or mold, it is removed by first shrinking it radially in any suitable way, as in a refrigerating-chamber, and by then withdrawing the resulting duplicate record by a direct longitudinal movement. Owing to the shallowness of the phonographic-record groove this radial shrinkage of the duplicate record effects a sufficient separation of the surfaces of the matrix and of the duplicate record to prevent injury to the surface of the duplicate record due to any longitudinal contraction thereof.

I find that by the process above described, and particularly when a matrix or mold is obtained by a process of vacuous deposit, as explained, duplicate phonographic records can be obtained which will be accurate reproductions of the original records and be free from extraneous noises and wherein the quality and intensity of the original vibrations will be reproduced with absolute faithfulness. I find, moreover, that since by this process there is little or no wear upon the matrix or mold a practically unlimited number of duplicates may be obtained from a single matrix or mold.

The degree of heat necessary to properly expand the blank will depend largely upon the material of which the blank is formed and upon the closeness of fit of the blank when inserted within the matrix or mold. For the same reasons the extent of the reduction of temperature in chilling and shrinking the duplicate record will vary to a considerable extent.

The invention is illustrated in the accompanying drawings for convenience in connection with a cylindrical phonogram.

In the drawings, Figure 1 is a sectional view showing a matrix or mold with a blank introduced therein prior to the expansion of the blank into engagement with the record-surface of the matrix; Fig. 1^a, a section through a part of the walls of the blank and matrix very greatly enlarged; Fig. 2, a view similar to Fig. 1, showing the blank expanded into engagement with the matrix and illustrating also a tapered mandrel forced into the blank; Fig. 2^a, a view corresponding to Fig. 1^a, showing a part of the walls of the matrix, blank, and mandrel of Fig. 2, very greatly enlarged; Fig. 3, a view corresponding to Figs. 1 and 2 with the tapered mandrel removed and illustrating the formed duplicate as having been contracted radially preparatory to being removed from the blank by a direct longitudinal movement; and Fig. 3^a, a section, very greatly enlarged, corresponding to Figs. 1^a and 2^a and illustrating the relative relation between the duplicate and matrix prior to the removal of the former.

In the views corresponding parts are represented by the same letters of reference.

A represents the matrix or mold, carrying on its bore a negative representation of the record to be reproduced.

B represents the blank to be duplicated, which is preferably provided with a tapered bore, as is now common, and which is of sufficient thickness to maintain its shape during and after the act of disengagement from the matrix. This blank is turned down so that it may be inserted within the matrix or mold with a close fit, as shown in Figs. 1 and 1^a. The blank to be duplicated may be and preferably is of a harder material than can be practically or satisfactorily engraved, indented, or cut by a phonographic recorder, whereby the duplicate phonographic records will be more durable than could be obtained in the first instance by the operation of a recording or indenting device actuated directly by the sound-waves. These blanks may therefore be made of a relatively hard material, such as asphalt, or of stearic acid or stearate of soda mixed with varying proportions of fine precipitates—such as chalk, slaked lime, or lampblack—or waxes or resins may be used, such as sealing-wax or shellac mixed with fine precipitates, like chalk, or polished ebonite, vulcanized hard rubber, or celluloid may be used, or glue may be employed either alone or mixed with precipitates, such as chalk.

C, Figs. 2 and 2^a, represents a tapered mandrel, which may be inserted within the blank B.

D represents a support for the matrix or mold and for the blank within the same, said support having an opening E therein, whereby the mandrel C may be moved longitudinally within the blank.

In carrying out the process I first introduce the blank within the matrix with as close a fit as practical, as shown in Figs. 1 and 1^a, after which the mandrel C is inserted within the blank. These parts are then subjected to heat, such as by being maintained in a heated atmosphere, whereby the blank will, by reason of its greater coefficient of expansion than the matrix or mold, be expanded into intimate contact with the record-surface of the latter, and an impression of such record will be accurately received on the blank. When the blank has been thus expanded into engagement with the matrix or mold, the mandrel C is forced tightly within the blank, so as to further expand it mechanically, whereby the blank will be forced into absolute intimacy with the record, and an impression will be received on the blank which will be clear, sharp, and an absolutely faithful reproduction of the original record. After the mandrel has been forced within the blank it is immediately withdrawn, and the blank is then chilled in any suitable way, such as by placing the matrix, with the blank contained therein, in a refrigerating-chamber. In this way the blank or duplicate will shrink or contract radially, as shown in Figs. 3 and 3^a, sufficiently to be removed from the matrix or mold by a direct longitudinal movement. Owing to the extreme shallowness of the phonographic-record groove, a sufficient radial separation between the resulting duplicate and the matrix or mold will take place to prevent any longitudinal contraction of the duplicate from injuring the record-surface thereof.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. The process of duplicating sound-records that consists in impressing a plastic record-tablet against a suitable matrix by its own expansive force.

2. The method of producing hollow cylindrical phonograms, which consists in obtaining a mold having a reverse phonogram-record on the inner wall of a cylindrical opening, forming a hollow cylindrical plastic phonogram within said mold, releasing the phonogram from the mold by a radial contraction of the phonogram sufficient to entirely clear the surfaces, and removing the phonogram from the mold by direct longitudinal movement.

3. The method of producing hollow cylindrical phonograms which consists in obtaining a mold having a reverse phonogram-record on the inner wall of a cylindrical opening, forming a hollow cylindrical plastic phonogram within said mold, releasing the phonogram from the mold by a reduction in temperature sufficient to entirely clear the surfaces, and removing the phonogram from the mold by direct longitudinal movement.

4. The method of producing phonograph-cylinders which consists in placing within a hollow cylindrical record mold or matrix, a hollow cylindrical phonograph-blank of sufficient thickness to maintain its shape during and after its engagement with the matrix, outwardly expanding such blank against said matrix, disengaging the impressed record-cylinder from the matrix, and withdrawing said record-cylinder from the matrix by direct longitudinal movement.

5. The method of producing phonograms which consists in placing within a hollow cylindrical record-matrix a hollow cylindrical phonograph-blank of sufficient thickness to maintain its form under normal conditions, softening said blank by heat and expanding the same while heated so as to take the record from the matrix, shrinking the phonogram so made by change of temperature, and withdrawing the same from the matrix by direct longitudinal movement.

6. The method of producing phonograms which consists in placing within a hollow matrix a hollow body of plastic material, said body being a cylinder on its outer surface and having a tapering central longitudinal aperture, softening said body by heat and expanding it into the matrix by the longitudinal movement of a tapering plunger within the plastic body, shrinking the plastic material and withdrawing it from the matrix by direct longitudinal movement.

7. The process of duplicating phonograms having a phonographic record thereon, which consists in forming a matrix or mold wherein the original record will be reproduced in relief, in loosely engaging a blank phonogram with said matrix, and in finally intimately engaging the blank phonogram with said matrix or mold by changes in temperature, substantially as set forth.

8. The process of duplicating phonograms having a phonographic record thereon, which consists in depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief, and in intimately engaging a blank phonogram with the said matrix or mold by a change in temperature, substantially as set forth.

9. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief, in inserting the continuous cylindrical blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth.

10. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal upon the original phonogram so as to form a matrix or mold, in inserting the blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, in finally shrinking the blank to disengage it from the matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth.

11. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief, in inserting the blank to be reproduced within said matrix or mold, in heating the blank, whereby the same will be expanded into engagement with the record in relief carried by the bore of said matrix or mold, and in finally subjecting the expanded blank to pressure to more intimately engage it with said record, substantially as set forth.

12. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal on said phonogram to form a matrix or mold wherein the original record will be reproduced in relief, in inserting the blank to be reproduced within said matrix or mold, in heating the blank, whereby the same will be expanded into engagement with the record in relief carried by the bore of said matrix or mold, in subjecting the expanded blank to pressure to more intimately engage it with such record, and in finally chilling the blank to remove it from the matrix or mold, substantially as set forth.

13. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal upon the original phonogram to form a matrix or mold, in covering said matrix or mold with a metal backing, in introducing the continuous cylindrical phonogram to be reproduced within said matrix or mold, in expanding said phonogram into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth.

14. The method of producing phonograms, which consists in securing a hollow metallic mold or shell containing the reverse record, placing in said mold an expansible blank sufficiently thick to maintain its shape during and after its removal from the mold, expanding both by heat, impressing the record in the blank, contracting the phonogram so made by the withdrawal of heat, and removing the phonogram from the mold by a direct longitudinal movement, substantially as set forth.

15. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing a metal upon the original phonogram so as to form a matrix or mold, in inserting within said matrix or mold a blank to be reproduced made of a material having a higher coefficient of expansion than said matrix or mold, and in heating the blank and matrix carried thereby, whereby the blank will be expanded into intimate engagement with the record in relief carried by the bore of said matrix or mold, substantially as set forth.

16. The process of duplicating cylindrical phonograms having a phonographic record thereon, which consists in depositing in a vacuum a metal vapor upon the original phonogram, electroplating a metal thereon so as to form a matrix or mold, in inserting the continuous cylindrical blank to be reproduced within said matrix or mold, in expanding the blank into intimate engagement with the record in relief carried by the bore of said matrix or mold, the cylindrical blank being made sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder by direct longitudinal movement, substantially as set forth.

17. The method of producing record-cylinders for phonographs, which consists in first forming a record on a cylinder of wax or other relatively soft material, rendering the surface of the wax cylinder electrically conductive, and electrolytically depositing metal thereon forming a matrix, and then outwardly

expanding under pressure within the matrix a cylinder or tube of softened material sufficiently thick to maintain its shape during and after the act of disengagement from the matrix, and finally removing the cylinder or tube by direct longitudinal movement.

18. The herein-described process of molding sound-records in celluloid, which consists of softening a celluloid tablet and then forcing the same against a suitable matrix by its own expansive force, substantially as described.

This specification signed and witnessed this 21st day of February, 1898.

THOMAS A. EDISON.

Witnesses:
J. F. RANDOLPH,
RICHD. N. DYER.

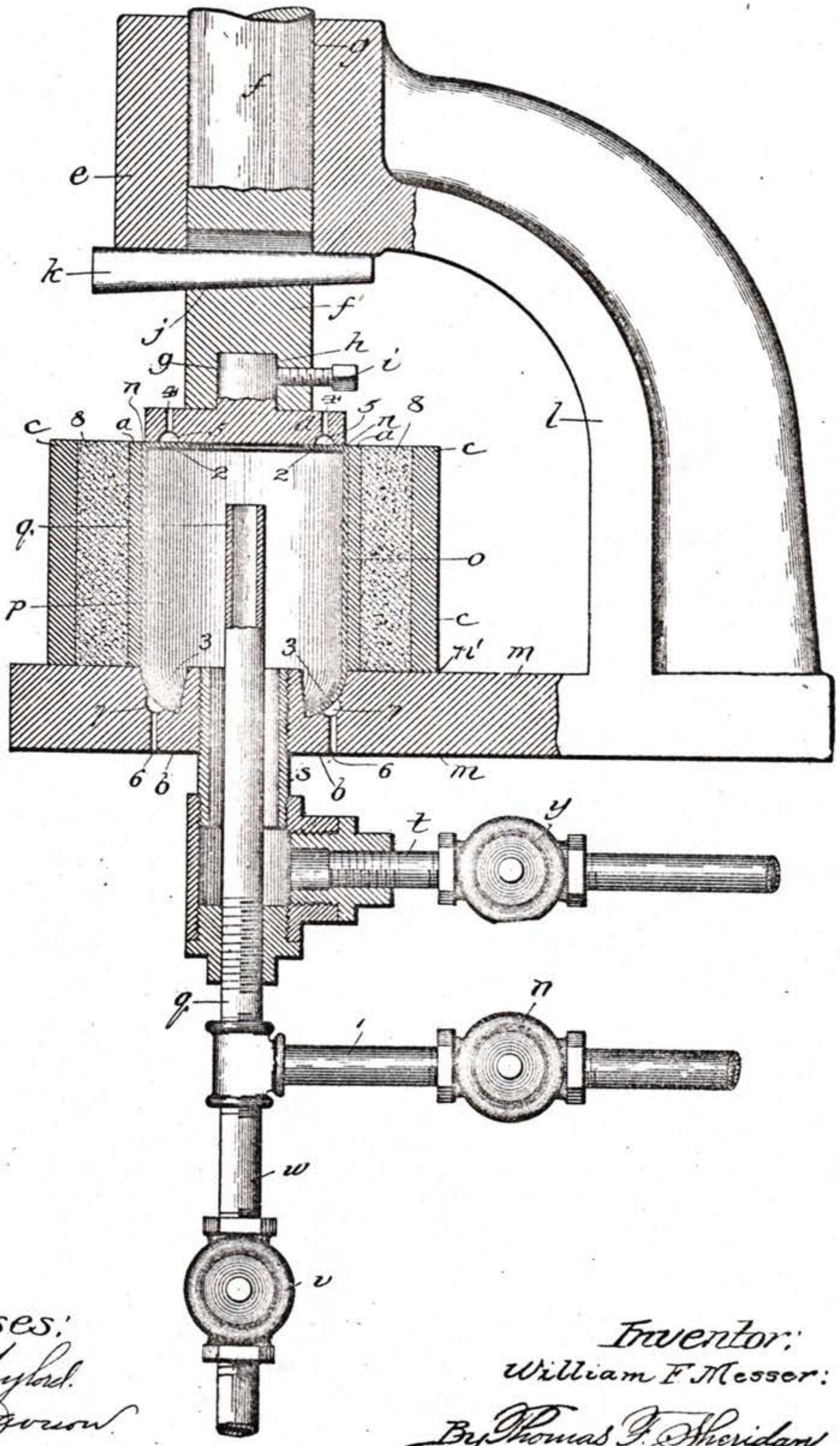
No. 705,772. Patented July 29, 1902.

W. F. MESSER.

APPARATUS FOR REPRODUCING PHONOGRAMS.

(Application filed Feb. 1, 1902.)

(No Model.)



Witnesses:
Chas. E. Gaylord.
Geo. C. Dawson

Inventor:
William F. Messer:
By Thomas F. Sheridan
Att'y

UNITED STATES PATENT OFFICE.

WILLIAM F. MESSER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE LAMBERT COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

APPARATUS FOR REPRODUCING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 705,772, dated July 29, 1902.

Application filed February 1, 1902. Serial No. 92,110. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. MESSER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for Reproducing Phonograms, of which the following is a specification.

This invention relates to that class of apparatus by which duplicate phonographic records in any desired number may be made, and particularly to the production of what are termed "indestructible" records or records made of celluloid or similar infrangible material, and more especially to the production of records having relatively thin walls of celluloid and inwardly-extending annular end flanges.

The principle object of the invention is to provide a simple, economical, and efficient apparatus for reproducing phonograms or record-cylinders in any desired number.

A further object of the invention is to provide means for holding the ends of the record-cylinder in place against the inner walls of the base and head, so as to seal the pressure-chamber while pressure is being applied to force the record-cylinder against the matrix and hold the record-cylinder sufficiently out of intimate contact with the matrix at each end to permit the escape of air from between the ends of the record-cylinder and matrix until the entire outer surface of the cylinder has been pressed against the inner surface of the matrix.

Other objects will appear from an inspection of the drawing and the following description and claims.

The accompanying drawing represents a vertical side elevation in section of one style of an apparatus constructed in accordance with my improvements.

In constructing a machine in accordance with my improvements and using the same I provide a matrix *a* of the desired size, shape, and strength and which is preferably formed in the manner shown and described in Patent No. 645,920, issued to Thomas B. Lambert March 20, 1900. The matrix is in the form of a hollow cylinder open at both ends and is provided on its inner surface with sound-record indentations—that is to say, it has negative indentations corresponding to those upon the original sound-record—so that when the record-blank receives the imprint of the inner surface of the matrix it becomes a duplicate of the original or master record. This matrix is placed in an upright position upon a base *b*, which forms a closure for one end of the matrix, the natural irregularities of the end of the matrix and surface of the base forming an outlet sufficient to permit the air to escape from between the blank record and matrix. The matrix is surrounded by an encircling metallic shell *c*, between which and the matrix a backing S, of plaster-of-paris or similar material, is placed for holding the matrix in place and affording the desired and necessary rigidity and strength to withstand the pressures incident to its operative use. A movable head portion *d* is provided and mounted above the matrix by means of a stem *f*, extending therefrom through a bearing *g* in a stationary head *e*. The stem of the movable head may be integral therewith or connected thereto, as shown, by suitable means, such as the lug *g* upon the head, fitted into a slot or notch *h* in the stem and held in place in such stem by a set-screw *i*, connecting the lug and stem. A transverse perforation *j* is made in the stem of the movable head adapted to receive a wedge *k*, which contacts with the stationary head, and thereby holds the stem and movable head in the desired position with relation to the matrix. A rigid standard *l* and bottom portion *m*, both preferably integral with the stationary head and base, connect such head and base and hold them in fixed rigid relation to each other and should be of sufficient strength to hold the movable head in position against the pressure to be applied between such head and base. The movable head is made of such diameter as to leave a space *n* between it and the matrix when both are in operative position, thus permitting the air to escape from between the record-blank and the matrix when pressure is applied to the inner side of the record-blank. By this arrangement a chamber is formed between the matrix, the movable head, and the base, which chamber is provided with vents *n* and *n'* at the top and bottom of the matrix. A blank record-cylinder *o*, of celluloid or similar material, is then placed within the chamber with its respective ends in contact with the head and base. An inner pressure-chamber *p* is thus formed between the record-cylinder and the head and base portion, which is or becomes hermetically sealed upon the admission of steam under pressure thereto, as hereinafter described. It is desirable to first soften the record-cylinder, so that it may be expanded against the record-surface of the matrix. In order to accomplish this, a heated fluid, preferably steam under about fifty pounds pressure to the square inch, is forced into the record-chamber through a pressure-supply pipe *q*, which is connected by means of a branch pipe *r* with a suitable source of steam-supply. The steam is permitted to escape through an exhaust-pipe *s*, connected with the outer air by means of a pipe *t*. The steam is kept at a substantially uniform pressure within the record-chamber, so as to by means of its peculiar heating qualities and other actions soften the record and force it out against the inner indented surface of the matrix. After this has been accomplished the steam-supply is shut off by means of a valve *u*, and a supply of cold air under pressure is permitted to enter through the supply-pipe *q* by opening the valve *v* on a second branch pipe *w*, which connects with a source of cool air under pressure and keeps up as great or a greater pressure than before. A valve *y* on the exhaust-pipe may be left open, so that all moisture and steam are blown out of the cylinder formed by the record. When the steam has been blown out, the next step is to close the valve *y* and permit cool air under pressure to remain in the record-chamber until such blank record is sufficiently cooled and hardened. Thus cooled and shrunk it is easily removed without collapsing.

As shown in the drawings, the record-cylinder is for many purposes preferably made with internal end flanges 2 and 3, and when thin material is used, as above suggested, such flanges are softened as well as the body of the record by the admission of steam under pressure. When steam under pressure is admitted, they are immediately softened and forced against the head on one end and the base on the other, and some of the fluid under pressure naturally escapes around such end before the hermetical seals are formed. If this fluid under pressure is not taken care of immediately—that is, permitted to escape from all contact with the record-surface—or if it is allowed to get between the record and the matrix, there is great danger of the surface of the phonogram being either destroyed or so impaired that it is of little or no value. It becomes necessary, therefore, to provide means by which all fluid, such as air or steam, outside of the hermetically-sealed chamber may be immediately permitted to escape and that the end flanges be hermetically sealed to the head and base as quickly and firmly as possible. In order to accomplish these results, the head portion is provided with perforations 4, arranged in a circle adjacent to the inner edge of the record and at the desired distance from its outer edge. An annular groove 5 is thus provided in the inner surface of the head, into which the perforations open. In the same manner as above described in connection with the head and for the same purposes with relation to the opposite end flange and base portion perforations 6 and an annular groove 7 are provided in the inner surface of the base portion. By means of these perforations in the head and base, in connection with the other elements described, when fluid under pressure, such as steam, is admitted to the pressure-chamber formed within the record-cylinder it follows the path of least resistance and presses toward the perforations in the head and base, carrying the adjacent flanges of the record-cylinder with it, pressing them tightly in place against the end walls or base and head, and forming a sealed chamber. The perforations being left open throughout the operation of completing the record, the flanges are thus held in position to prevent the escape of steam or other fluid from the chamber within the record-cylinder by forming a sealed connection between the record-cylinder and the head and base. It should be understood, however, that the perforations in the head and base should only be sufficiently large to permit the desired yielding of the record-blank and prevent the escape of the fluid by blowing a puncture through the material of which the flange is formed. I find in practice that perforations one-fiftieth of an inch in diameter serve the purpose. An annular space one five-thousandth of an inch wide is sufficient between the head and matrix to permit the air to escape from between the record-cylinder and matrix and may be formed by either making the head of such diameter as to leave a sufficient space or by holding the head a sufficient distance from the matrix to leave a space of the desired size. I prefer, however, to employ a head of smaller diameter than the inner diameter of the matrix. It will be also readily apparent to those skilled in the art that the annular groove in either the head or base would operate with more or less success to hold the end flanges and thereby the ends of the record-cylinder in place with one vent or perforation communicating with such groove; but I prefer to employ a plurality of perforations or vents.

I claim—

1. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder, and a head portion arranged in contact with the other end of the record-cylinder and provided with outlet means communicating with the inner surface of such head and extending to the outer surface of such record-cylinder, substantially as described.

2. In an apparatus of the class described, the combination of a cylindrical matrix, a base

portion at one end thereof arranged to contact with the end of a blank record-cylinder and provided with outlet means communicating with the inner surface of such base and extending to the outer surface of such record-cylinder, and a head portion arranged in contact with the other end of the blank record-cylinder, substantially as described.

3. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder and provided with perforations extending through such base and communicating with the inner surface thereof, and a head portion arranged in contact with the other end of the blank record-cylinder and provided with perforations in such head communicating with the inner surface thereof, substantially as described.

4. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder arranged within the matrix and provided with a groove in its inner surface and perforated outlet means through such base communicating with the groove, and a head portion arranged at the other end of the record-cylinder forming in connection with the record-cylinder and base a pressure-chamber, substantially as described.

5. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a record-cylinder and provided with a groove in its inner surface and with outlet means through such base communicating with such groove, and a head portion arranged in contact with the other end of the record-cylinder and provided with a groove in its inner surface and with outlet means through such head communicating with the groove, substantially as described.

6. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder, and a head portion arranged in contact with the other end of the blank record-cylinder and providing an opening communicating with the inner surface of the matrix outside of the record-cylinder and provided with perforations communicating with the inner surface of such head, substantially as described.

7. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder and provide a vent communicating with the inner surfaces of the matrix and provided with outlet means communicating with the inner surface of such base and extending to the outer surface of such record-cylinder, and a head portion arranged in contact with the other end of the record-cylinder to form in connection with the record-cylinder and base a chamber within such record-cylinder, substantially as described.

8. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion at one end thereof arranged to contact with the end of a blank record-cylinder having inwardly-extending end flanges, a head portion arranged in contact with the inner flange on the other end of the record-cylinder provided with perforations communicating with the inner surface of such head at points adjacent to the inner edge of such end flange and extending to the outer surface of such record-cylinder, substantially as described.

9. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion arranged at the end thereof in contact with the end portion of a blank record-cylinder having inwardly-extending flanges, such base portion being provided with perforations communicating with the inner surface thereof at points adjacent to the inner edge of the end flange of the record-cylinder, and a head portion arranged in contact with the opposite end of the record-cylinder and the end flange thereon and provided with perforations through such head communicating with the inner surface of the head at points adjacent to the inner edge of such end flange, substantially as described.

10. In an apparatus of the class described, the combination of a cylindrical matrix, a base portion arranged at one end thereof in contact with the end of a blank record-cylinder and provided with perforations extending through such base and communicating with the inner surface thereof, a head portion arranged in contact with the other end of the blank record-cylinder and provided with perforations in such head communicating with the space between it and the record-cylinder, a frame for holding the base in position, and means for admitting fluid under pressure to the chamber formed within the record-cylinder between the base and head, substantially as described.

11. In an apparatus of the class described, a movable head portion adapted to close the end of a blank record-cylinder and provided with perforations through such head portion communicating with the inner surface thereof and extending to the outer surface of such record-cylinder, substantially as described.

12. In an apparatus of the class described, a base portion adapted to close one end of a blank record-cylinder to be operated upon and provided with perforations through such base portion communicating with the inner surface thereof and extending to the outer surface of such record-cylinder, substantially as described.

WILLIAM F. MESSER.

Witnesses:
THOMAS E. SHERIDAN,
HARRY IRWIN CROMER.

(No Model.)

T. A. EDISON.

PHONOGRAM BLANK.

No. 382,418. Patented May 8, 1888.

Fig. 1.

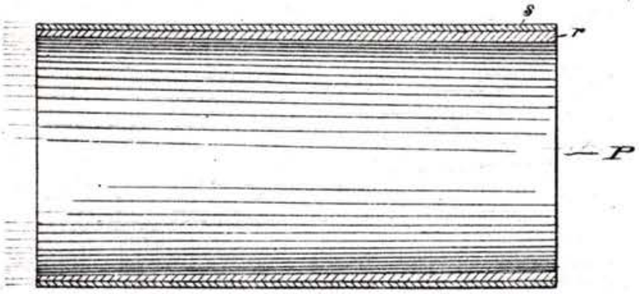
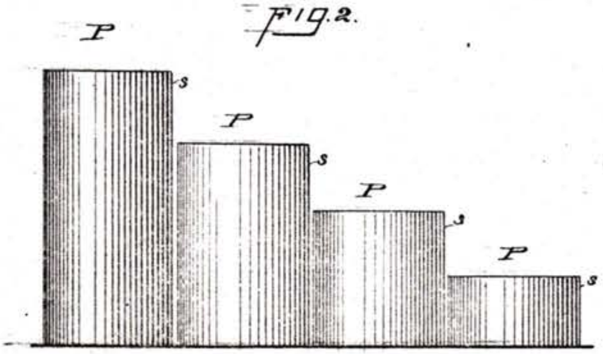


Fig. 2.



Witnesses.
E. C. Rowland
William Pelzer

Inventor.
Thomas A. Edison.
By his Attorneys
Dyer & Seely

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 382,418, dated May 8, 1888.

Original application filed November 26, 1887 Serial No. 256,189. Divided and this application filed March 2, 1888. Serial No. 265,889. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks and Phonograms, (Case No. 762, division of Case No. 741,) of which the following is a specification.

The object I have in view is to produce a cylindrical phonogram-blank or phonogram which can be readily placed upon the phonogram-cylinder of a phonograph, and will center itself, and will also be adapted to retain its place upon the phonogram-cylinder by friction alone. This I accomplish by providing the cylindrical phonogram-blank or phonogram with a tapering bore adapted to fit over a similarly-tapered phonogram-cylinder. The phonogram-blank or phonogram is provided with a cylindrical recording-surface. Blanks or phonograms of the full length of the tapering phonogram-cylinder of the phonograph can be used as well as those of shorter length, the tapering bore centering the blank or phonogram, and adapting it to be pushed onto the phonogram-cylinder until it binds thereon with sufficient friction to hold it in place.

In the accompanying drawings, forming a part hereof, Figure 1 is a sectional view of a phonogram-blank or phonogram, showing by dotted lines its division into sections; and Fig. 2 an elevation, showing four different sizes of the phonogram-blank or phonogram.

P represents phonogram-blanks or phonograms. They have a cylindrical recording-surface, *s*, made of wax, or a wax-like substance, which may be mounted upon a backing, *r*, which is also a cylinder, but has a tapering bore adapted to fit upon a similarly-tapered phonogram-cylinder of a phonograph.

I propose to make these phonogram-blanks the entire length of the phonogram-cylinder, and also to divide such full-length phonogram-blanks into parts, so that sectional phonogram-blanks will be produced, which will be, for illustration, one-fourth, one-half, and three-fourths the length of the full-size phonogram-blanks. All of these sectional phonogram-blanks, as well as the full-sized phonogram-blank, will have the tapering bore, so that they can be pushed upon the tapering phonogram-cylinder until they bind, and the instrument can then be adjusted to them for recording and reproducing.

I do not claim herein a phonogram-blank having a recording-surface of wax, or a wax-like material, nor such a surface mounted upon backing of tougher material, such matters being covered by my application for patent, (Case No. 734, Serial No. 252,964,) filed October 21, 1887.

What I claim is—

1. A phonogram-blank or phonogram having a bore tapered throughout its length, substantially as set forth.

2. A phonogram blank or phonogram having a cylindrical recording-surface and a tapering bore, substantially as set forth.

3. A phonogram-blank or phonogram having a cylindrical recording-surface of wax or wax-like material and provided with a tapering bore, substantially as set forth.

This specification signed and witnessed this 20th day of February, 1888.

THOS. A. EDISON.

Witnesses:
WILLIAM PELZER,
E. C. ROWLAND,

(No Model.)

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

No. 382,419. Patented May 8, 1888.

Fig. 1.

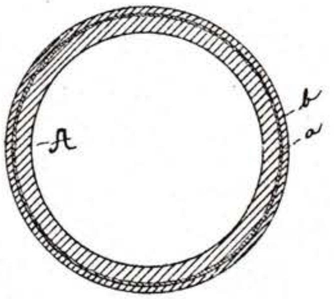


Fig. 2.

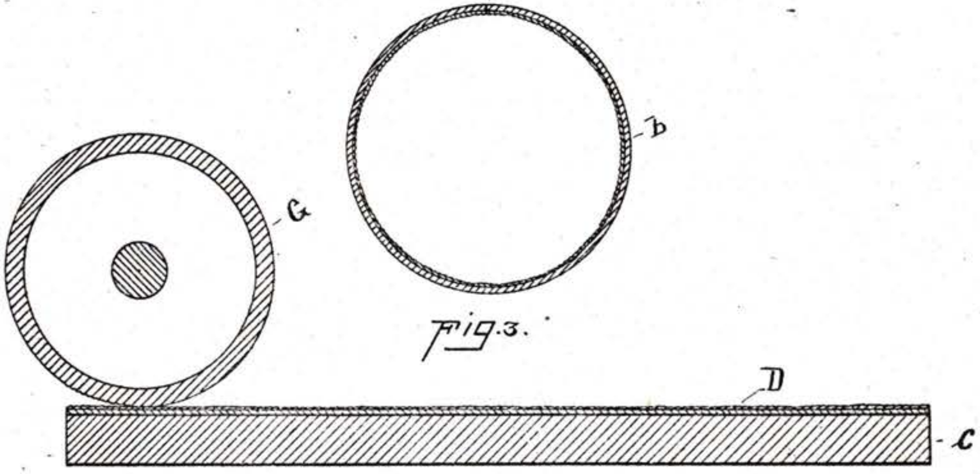
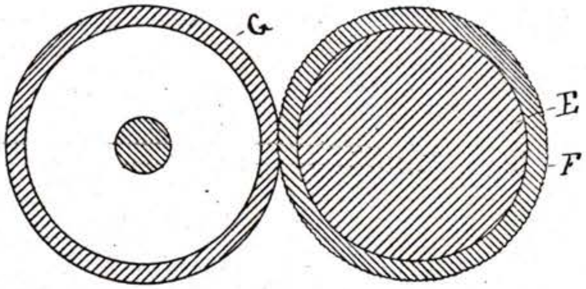


Fig. 3.

Fig. 4.



Witnesses
E. C. Rowland
William Pelzer

Inventor.
Thomas A. Edison.
By his Attorneys Dyer & Seely

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 382,419, dated May 8, 1888.

Application filed March 8, 1888. Serial No. 266,596. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Processes for Duplicating Phonograms, (Case No. 765,) of which the following is a specification.

The object of my invention is to produce a simple and efficient process for duplicating phonographic records. In applications already filed by me I describe a process for duplicating phonograms, wherein a metallic matrix is formed by depositing metals over the surface of cylindrical wax phonograms and then dissolving out the wax, leaving a hollow matrix or mold with the record in relief upon its inner surface. By my present invention I propose to apply the process of knurling to the duplication of phonograms as distinguished from molding. In my English Patent No. 1,644 of 1878 I proposed to construct a knurl by depositing metal over the record; but it is obvious that if this deposit were made of any thickness at all the record would be largely obliterated.

By my present invention I deposit metals over the record of the recording surface of a cylindrical wax phonogram, and after melting out the original wax I divide the remaining cylinder by splitting it longitudinally with a thin saw on one side. I then open the cylinder out flat or further bend it into the form of a cylinder, with the record upon its exterior. To give the necessary strength I provide a suitable backing. The result is a flat or cylindrical knurling surface having the record in relief, so that by rolling a wax phonogram-blank upon it the original record will be reproduced.

For making the first deposit upon the original wax phonogram I prefer to employ silver, which is deposited upon the wax phonogram by the vacuum process or by electroplating. A thin coating is produced in this way, which is backed up by a coating of lead or tin, which is also quite thin. For example, it may be one-sixteenth of an inch in thickness. The silver gives an inoxidizable surface, which is cheaper than gold or platinum. After the wax is dissolved out and this cylinder split on one side it will be found to have sufficient flexibility by reason of the materials employed and the thinness of the cylinder to permit of its being bent without injury to the record into the form of a flat sheet or a reversed cylinder. If bent around a cylinder it will be secured to the same by cement, and if bent into a flat sheet it will likewise be secured to a suitable bed-plate, the cylinder or bed-plate giving the necessary strength to the record. The duplicate phonogram-blanks upon which I impress the original record by means of the knurl are preferably of a wax composition, which is too hard to be practically indented directly in the phonograph, although softer compositions may be employed, or materials other than wax.

In the accompanying drawings, forming a part hereof, Figure 1 is a sectional view showing the original phonogram with the deposit thereon; Fig. 2, a similar view with the original phonogram melted out or removed from the encircling metal deposit. Fig. 3 is a sectional view illustrating the flat knurling-surface, and Fig. 4 a similar view illustrating the cylindrical knurling-surface.

A is the original wax phonogram, upon the surface of which is the phonographic record, upon which is formed a thin deposit of silver, *a*, and over this a thicker deposit of lead or tin, *b*, the entire metallic deposit being, for illustration, one-sixteenth of an inch thick. After this deposit is made the wax cylinder A is melted out of the metal coating, leaving the metallic cylinder B (shown in Fig. 2) with the record in relief upon its inner surface. This cylinder B is split longitudinally on one side at the point *c*, and it is then bent out flat and mounted upon a suitable base-plate, C, to which it is secured by cement, forming a flat knurling-surface, D; or the cylinder B may be bent reversely over a solid cylinder, E, and secured thereto by cement, forming a cylindrical knurl, F. (Shown in Fig. 4.) The wax duplicate phonogram-blank G is impressed with the original record by rolling it against the flat or the cylindrical knurling surface, as will be readily understood.

I do not claim herein the method of duplicating phonograms by depositing metals upon a cylindrical wax phonogram and then melting or dissolving out the original wax phonogram, leaving a matrix with the record in relief upon its inner surface; neither do I claim herein the use of a vacuum deposit for producing a coating upon the wax phonogram; neither do I claim herein a duplicate phonogram constructed of a hard material not capable of being satisfactorily indented by a phonograph, since these features are covered in my applications Nos. 743, 744, and 751, already filed by me. Such applications have respectively the Serial Nos. 259,895, 259,896, and 262,428.

What I claim as my invention is—

1. The process of duplicating phonograms, consisting in forming a knurl having the original record in relief by depositing metal upon the original record, removing the original phonogram and opening the metallic coating, and then impressing duplicate phonogram-blanks with the original record by means of such knurl, substantially as set forth.

2. The process of duplicating phonograms, consisting in depositing a flexible metallic coating upon an original cylindrical phonogram, removing the original phonogram from the inclosing-coating, splitting the inclosing-coating longitudinally, bending the same to form a knurl, and then impressing the duplicate phonogram-blanks with the original record by means of this knurl, substantially as set forth.

This specification signed and witnessed this 3d day of March, 1888.

THOS. A. EDISON.

Witnesses:
Wm. Pelzer,
E. C. Rowland.

(No Model.)

T. A. EDISON.

PHONOGRAM BLANK.

No. 382,462. Patented May 8, 1888.

Fig. 1.

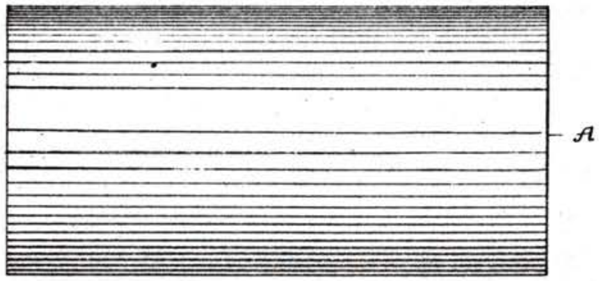


Fig. 2.

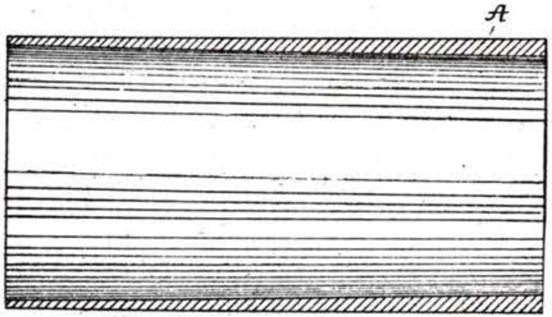
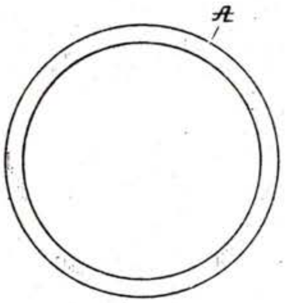


Fig. 3.



Witnesses.
E. C. Rowland,
William Pelzer.

Inventor.
Thomas A. Edison.

By his Attorneys Dyer & Seely.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 382,462, dated May 8, 1888.

Application filed January 5, 1888. Serial No. 259,898. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks and Phonograms, (Case No. 747,) of which the following is a specification.

I have found in practice that the most available surface for phonogram-blanks and phonograms is one composed of wax, gum, or other plastic hydrocarbon. Such compounds, however, I find contract and expand under variations of temperature to a much greater extent than paper, wood, metals, and other similar harder substances. While under ordinary conditions the wax or wax-like surface may not be injured by this difference in the coefficient of expansion, yet when subjected to extreme cold the contraction of the wax is so much greater than the harder backing that the wax will crack and destroy the continuity of the surface. For instance, a phonogram-blank or phonogram may be subjected to a temperature of nearly 100° Fahrenheit at one time and at another time the temperature may fall below zero. If the waxy substance is sufficiently hard at the high temperature to hold its shape under the pressure of one on the other in a packing-box, it will at the low temperature harden and contract so greatly in excess of the backing of harder material that the wax will crack and render the surface useless.

The object I have in view is to produce a phonogram-blank or phonogram which will have the wax or wax-like surface and will not be subject to the objection that has been stated. This I accomplish by constructing the phonogram-blank or phonogram wholly of the wax or wax-like material. I prefer to mold the entire phonogram-blank of the one wax-like compound; but I may construct the base or backing of the surface of a somewhat different mixture of wax or wax-like materials than that of which the surface is made, so long as the whole has substantially the same coefficient of expansion.

My phonogram-blank I prefer to mold as a hollow cylinder with a tapering bore for slipping over the tapering phonogram-cylinder of my phonograph.

In the accompanying drawings, forming a part hereof, Figure 1 is an elevation of the phonogram-blank; Fig. 2, a longitudinal section thereof, and Fig. 3 an end view.

A is the cylindrical phonogram-blank, molded of the plastic wax or wax-like material, as described, and having a tapering bore.

The invention is also applicable to duplicate phonograms having the phonographic record thereon.

What I claim is—

1. A phonogram-blank or phonogram constructed wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

2. A phonogram-blank or phonogram constructed as a hollow cylinder wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

3. A phonogram-blank or phonogram constructed as a hollow cylinder, with a tapering bore wholly of wax or wax-like materials, and having the same coefficient of expansion throughout its mass, substantially as set forth.

This specification signed and witnessed this 5th day of December, 1887.

THOS. A. EDISON.

Witnesses:
WILLIAM PELZER,
E. C. ROWLAND.

(No Model.)

T. A. EDISON.

PHONOGRAPH.

No. 430,278. Patented June 17, 1890.

FIG. 1.

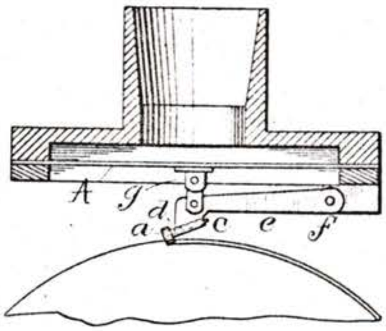


FIG. 2.

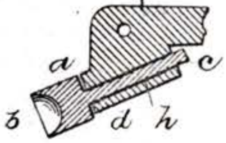


FIG. 3.

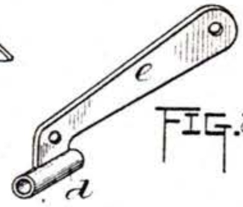


FIG. 4.

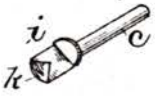


FIG. 5.

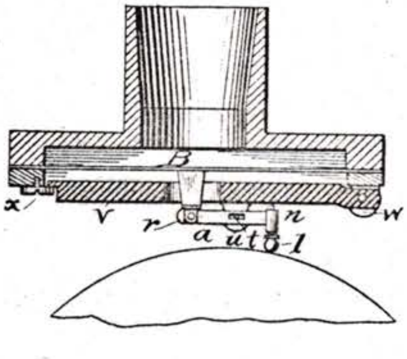


FIG. 6.

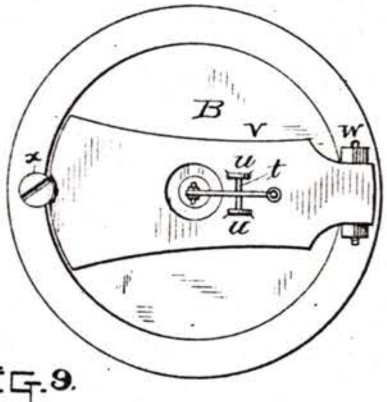


FIG. 7.

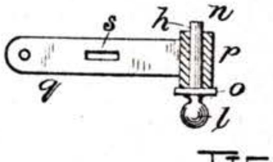


FIG. 9.

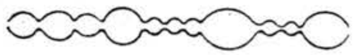
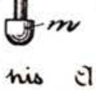


FIG. 8.



Witnesses

E. C. Rowland

William Pelzer

Inventor

Thomas A. Edison

By his Attorneys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 430,278, dated June 17, 1890.

Application filed April 10, 1889. Serial No. 306,670. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonographs, (Case No. 833,) of which the following is a specification.

This invention relates to the recording and reproducing points of the phonograph, and has for its objects such an improvement in the form and construction of such devices and in the manner of arranging and supporting the same as, in the first place, to materially improve the character of the sounds produced by the instrument, so as to make them more accurately reproduce the sound-vibrations communicated to the recorder than has heretofore been found possible; secondly, to make the instrument of a less delicate character and more readily manipulated and adjusted by inexperienced persons, and, thirdly, to enable the recording-point to be used for a longer period of time without having to be sharpened or reground or replaced by another.

One feature of my invention consists in the use of a recording-point having a cutting-edge, which is a portion of the edge of a cylinder and forms a gouging-edge, or one which cuts a rounded groove, so that the indentations due to the movements of such point are circular and with curved sides sloping to the center instead of square, and with straight sides, such as are produced by the straight-edged cutting-points which have heretofore been used. I prefer to employ a recording-point whose end is formed into a complete circular edge—that is to say, the end of a cylindrical head is cupped or hollowed out so as to produce a thin circular cutter, so that when one part of the edge becomes worn or dulled the stem may be turned and a different part of the circumference or a new curved cutting-edge is brought into position to operate on the phonogram-blank. To readily accomplish this and also to produce a means of holding the recording-point which shall enable the latter to be readily removed and easily replaced in position by unskilled persons, I provide the point with a shank which is inserted into a socket and held therein removably, preferably by means of a little cement, which can be readily softened by heat, such as a small quantity of shellac. I prefer to support the reproducing-point in the same way, so that it also can be readily removed and replaced when necessary. I employ, also, a reproducing-point having a convex circular bearing-surface—that is to say, a bearing-surface which is the surface of a portion of a sphere. I prefer to employ as a reproducing-point a ball or sphere at the end of a suitable stem. This is supported so that it has a slight movement laterally of the record, and when traveling in the circular depressions formed by the recording-point it fits such depressions, and even if the lever which carries it is out of line with the record, so that the ball does not stand vertically in the record, or if it bears against the curved sides of the depressions, it reproduces the vibrations with the same exactness. The effect of the weight of the reproducing-point and attached parts is such, however, that the point always tends to go to the bottom or center of a depression. With the curved recording-point the whole depression forms the record of the sound-wave, and not only the bottom of it as with a straight recording-point, so that if the spherical reproducer touches the surface of the depression at any point it gives an accurate reproduction.

If a straight-sided reproducing-point gets out of line or tilted laterally, it does not reproduce accurately, and with straight-sided depressions if the reproducing-point bears against the sides it does not reproduce perfectly and it cuts through the sides and scrapes against them so as to produce imperfect articulation and injure the record itself.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a section of the case and mouthpiece of the recorder with the recording-point and attached parts shown in elevation and with the point itself on an enlarged scale; Fig. 2, a longitudinal section of the recording-point and holder therefor; Fig. 3, a perspective view of the holder and the lever which carries it; Fig. 4, a perspective view of a modified form of recording-point; Fig. 5, a view of the reproducer, similar to Fig. 1; Fig. 6, a bottom view of the reproducer; Fig. 7, a side elevation of the reproducing-point and the parts which hold and support it, the tubular holder being shown in vertical section; Fig. 8, a view of a modified form of reproducing-point; and Fig. 9, an illustration of the form of the record produced by the arc-shaped recording-point, the view being of the character of a plan view.

The recording-point consists, preferably, of a cylindrical piece *a*, whose end is hollowed or cupped out, as illustrated in Fig. 2, so that a very fine and sharp circular edge *b* is formed. From the part *a*, which is the head of the recording-tool, a shank *c* extends, which is preferably round, and which enters a tubular holder *d*, attached by soldering or otherwise to the lower side of the usual lever *e*, pivoted at *f* on the rim of the reproducer, and connected at *g* with the center of the diaphragm A. Preferably the shank *c* is cemented in the holder *d* by the application of a little shellac or other suitable material *h*, which can readily be softened by heating it; but instead of this the secure removable attachment of the shank in the sleeve may be attained by suitable mechanical holding devices of various kinds, as will readily be seen.

It will be seen that only the lower portion of the circular tool meets the surface of the phonogram-blank, so that the cutting-edge in use at any time is shaped as the arc of a circle whose center is outside of the recording-surface. The circle of the cutting-edge is in practice exceedingly small, being necessarily exaggerated for illustration in the drawings. For a phonograph which has one hundred threads to the inch on its feed-screw, I prefer to make the diameter of the circular cutting-tool about forty-thousandths of an inch. It is of course not necessary for the production of the peculiar character of record desired that the edge shall be a complete circle. It may be a semi-circle or other portion of a circle, as illustrated in Fig. 4, in which the head *i* is formed at its lower side only with a cutting-edge *k*, shaped as the arc of a circle whose center is outside the recording-surface and provided like the other with a shank *c* for insertion in the holder. But by making it circular I provide several curved cutting-edges—two or more—and I enable the same recording-point to be used for a much longer time without having to be replaced or sharpened, for when any portion of the edge has been used long enough to become worn or dulled the cement in the holder may be softened by the application of a low degree of heat and the shank turned in the holder or withdrawn and inserted in a different position, so as to bring a fresh arc-shaped cutting-edge into operative position, and this may be repeated several times before the whole circumference has been used. It will be seen that this is an operation which does not require especially skillful manipulation, but can readily be performed by any one, and this is an important advantage because the phonograph must necessarily be placed usually in the hands of unskilled and inexpert persons. The advantages of the pecular form of holder are, however, not confined to its use with the circular cutting-edge, for this evidently is a desirable form of holder for recording and reproducing points of any character when the same are provided with shanks or extensions capable of being inserted and held in the holder, since it enables such recording or reproducing points to be readily removed and replaced by any one without the exercise of any especial skill or knowledge and without any delicate adjustment the parts being so arranged that when the head or other enlarged portion meets the holding-sleeve, the point is in the proper position for operation. It is evident, also, that the holding-sleeve and shank are not necessarily round in cross-section, since the same may readily be made square or of other polygonal shape. Of course in this case the shank cannot be turned in the sleeve; but it can readily be withdrawn, turned, and replaced in a new position.

The character of the record produced by the curved or arc-shaped cutting recording-tool is indicated in Fig. 9. It will be seen that such record takes the form of a series of circular pits or depressions whose walls curve toward the center or bottom point, and that the width of such depressions is in proportion to their depth, and also that every portion of each depression contains the record of the sound-wave, so that if the reproducer enters the depression and touches at any point it will receive the required movement corresponding to the impressed sound-wave.

The head of the reproducing-point is preferably a ball or sphere *l*, but it may be only a portion *m* of the sphere, as illustrated in Fig. 8. Such head preferably has a shank *n*, provided with a flange *o*, and such shank enters the holding-sleeve *p* until the flange meets the holder and is secured preferably in the same manner as hereinbefore described with reference to the recording-point—that is to say, by a small quantity of shellac or similar cement *h*, or screwed in.

The holder *p* is attached to or made in one piece with a lever *q*, which is connected at *r* in the usual manner by a hinge with the center of the reproducing-diaphragm B. The lever *q* has a slot *s*, and through such slot passes a pin *t*, extending between lugs *u*, which depend from a plate *v*, pivoted at *w* on the rim of the reproducer and kept from falling out of place by the head *x* of the screw on the opposite side of the rim from the pivot. The plate *v* forms a weight which bears on the reproducing-point and tends to force the same always to the bottom of the recorded indentations, the slot *s* allowing a slight lateral rocking movement of the reproducing-point so that if the lever is out of line with the record the point itself can rock into the required position, and its having a rounded bearing-surface makes it immaterial whether it stands straight in the depression or is inclined toward one side thereof. The weight *v* also forms a retarding device, such as is described and claimed in my patent, No. 397,280, dated February 5, 1889, since it does not move under the quick vibrations communicated to the reproducing-point by the sound-record, but under slow movements due to irregularities or inaccuracies of the surface of the phonogram or eccentric movements of rotation it yields and permits the reproducing-point to conform to such irregularities.

What I claim is—

1. In a phonograph, the combination, with a diaphragm, of a recording-point carried thereby having a curved cutting-edge, substantially as set forth.

2. In a phonograph, the combination, with a diaphragm, of a recording-point carried thereby having a circular cutting-edge, substantially as set forth.

3. In a phonograph, the combination, with a record-surface, of a recording-point having a curved cutting-edge and entering said record-surface in an oblique direction, substantially as set forth.

4. In a phonograph, the combination of a cylindrical phonogram-blank, a diaphragm, and a recording-point carried by the diaphragm having a curved cutting-edge, substantially as set forth.

5. In a phonograph, a recording-point having two or more cutting-edges, in combination with a holder holding such point normally in a fixed position, and in which such position may be changed to bring such cutting-edges successively into operating position, substantially as set forth.

6. In a phonograph, a recording-point having two or more arc-shaped cutting-edges, in combination with a holder holding said point normally in a fixed position, and in which the position of the point may be changed to bring such edges successively into operating position, substantially as set forth.

7. In a phonograph, a recording-point having a circular edge, in combination with a holder holding such point normally in a fixed position, and in which the position of the point may be changed, substantially as set forth.

8. In a phonograph, a recording-point having two or more cutting-edges, in combination with a holder in which the point may be turned to bring such cutting-edges successively into operating position, substantially as set forth.

9. In a phonograph, the combination of a recording or reproducing point having a shank or extension, and a sleeve for holding the same, substantially as set forth.

10. In a phonograph, the combination, with a holding-sleeve, of a recording or reproducing point having a shank, and an enlarged portion meeting said sleeve when the shank is inserted therein, substantially as set forth.

11. In a phonograph, a reproducing-point whose bearing-surface is the surface of a portion of a sphere, substantially as set forth.

12. In a phonograph, a spherical reproducing-point, substantially as set forth.

13. A sound-record consisting of circular indentations or depressions having rounded sides and corresponding to the sound-waves, substantially as set forth.

14. A sound-record consisting of circular indentations or depressions having rounded sides and corresponding to the sound-waves, in combination with a diaphragm and reproducing-point whose bearing-surface is the surface of a portion of a sphere, substantially as set forth.

15. In a phonograph, a reproducing-point pivoted so as to have a lateral movement, in combination with a weight bearing thereon, substantially as set forth

16. In a phonograph, a reproducing-point having a bearing-surface which is the surface of a portion of a sphere and pivoted so as to have a lateral movement, in combination with a weight bearing thereon, substantially as set forth.

17. In a phonograph, a reproducing-point having a bearing-surface which is the surface of a portion of a sphere and pivoted so as to have a lateral movement, substantially as set forth.

18. In a phonograph, a laterally-rocking spherical reproducing-point, in combination with a weight bearing thereon, substantially as set forth.

19. A sound-record consisting of circular indentations or depressions corresponding to sound-waves, in combination with a reproducing-point whose bearing-surface is the surface of a portion of a sphere, and which is pivoted so as to have a lateral movement, substantially as set forth.

20. In a phonograph, the combination of the reproducing-point, the lever carrying the same and connected with the diaphragm, the hinged plate, and the hinge-connection between said lever and said plate, substantially as set forth.

21. In a phonograph, the combination of the reproducing-point, the lever carrying the same and connected with the diaphragm and having a longitudinal slot, the hinged plate, the lugs on said plate, and the pin connecting said lugs and passing through said slot, substantially as set forth.

22. In a phonograph, a recording-point having a cylindrical head provided with a cutting-edge and a shank or extension, substantially as set forth.

23. In a phonograph, a recording-point having a cylindrical head with its end hollowed to form a circular cutting-edge, substantially as set forth.

24. In a phonograph, a recording-point hav-

ing a cylindrical head with its end hollowed to form a circular cutting-edge and a shank or contracted extension, substantially as set forth.

25. In a phonograph, a reproducing-point having a head whose bearing-surface is a portion of the surface of a sphere, and a shank or contracted extension, substantially as set forth.

26. In a phonograph, a reproducing-point having a spherical head and a contracted shank, substantially as set forth.

27. In a phonograph, a reproducing-point having a spherical head, a contracted shank, and a flange on said shank, substantially as set forth.

28. In a phonograph, the combination, with a diaphragm, of a sleeve connected with said diaphragm so as to receive motion therefrom and a recording or reproducing point removably and rigidly held in said sleeve, substantially as set forth.

29. In a phonograph, the combination of a diaphragm, a lever connected therewith, a sleeve carried by said lever, and a recording or reproducing point removably held in said sleeve, substantially as set forth.

30. In a phonograph, the combination of a diaphragm, a lever connected therewith, a sleeve carried by said lever, and a recording or reproducing point having a head and a shank or contracted extension removably held in said sleeve, substantially as set forth.

31. In a phonograph, a recording or reproducing point in combination with a holding-sleeve and a cement, such as will be softened by heat, holding said point in said sleeve, substantially as set forth.

32. In a phonograph, the combination of a recording-point having a curved cutting-edge and a reproducing-point having a rounded bearing-surface, substantially as set forth.

This specification signed and witnessed this 8th day of April, 1889.

THOMAS A. EDISON.

Witnesses:
WILLIAM PELZER,
D. H. DRISCOLL.

(No Model.)

G. H. HERRINGTON.

METHOD OF RECORDING SPEECH.

No. 397,856. Patented Feb. 12, 1889.

Fig 1

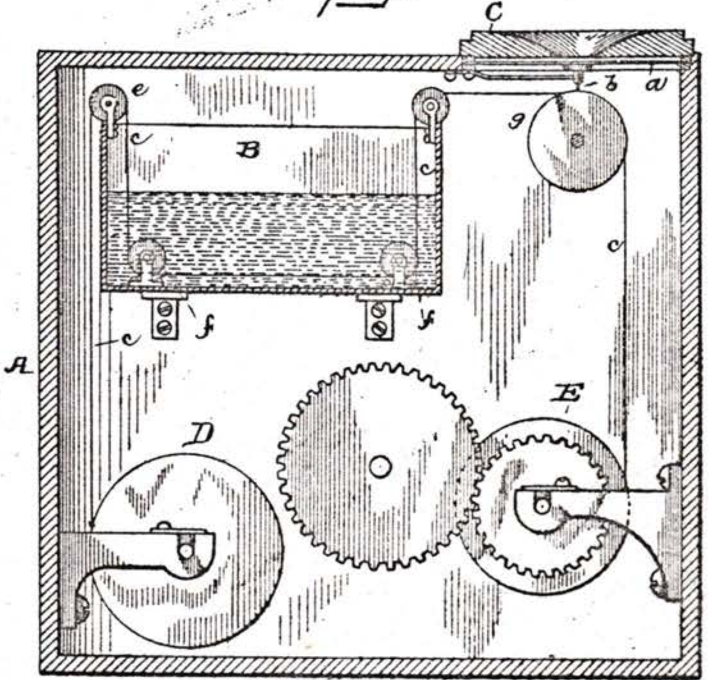


Fig. 2.

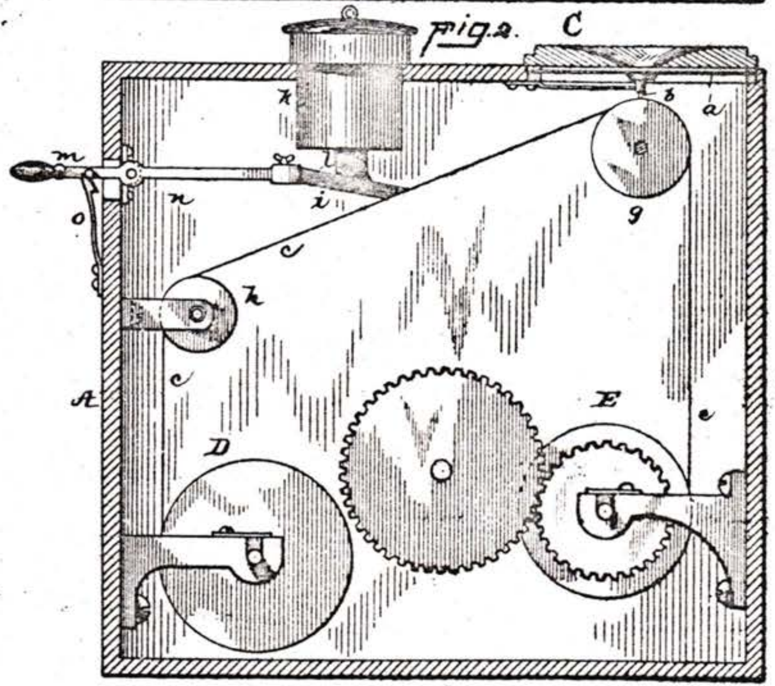


Fig. 3.

ATTEST:

E. C. Rowland.

William Pezer

INVENTOR:

George H. Herrington

By [illegible]

Atty.

UNITED STATES PATENT OFFICE.

GEORGE H. HERRINGTON, OF WICHITA, KANSAS, ASSIGNOR TO HIMSELF, AND EDWARD H. JOHNSON, OF NEW YORK, N. Y.

METHOD OF RECORDING SPEECH.

SPECIFICATION forming part of Letters Patent No. 397,856, dated February 12, 1889.

Application filed June 18, 1887. Serial No. 241,795. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. HERRINGTON, of Wichita, in the county of Sedgwick and State of Kansas, have invented a certain new and useful Improvement in Phonographs, of which the following is a specification.

In my application filed September 11, 1886, is set forth a process of recording sound-vibrations by softening a material, passing it under the needle of a phonograph, and then allowing it to cool. In the application referred to I described the use as the recording medium of a material capable of being softened by heat and hardening when cooled.

My present invention relates to another specific process to the same end, one of whose advantages is that the appliances required for heating and cooling the material are dispensed with.

My improvement consists, mainly, in the employment as a recording medium of a material which is softened by a chemical solvent before passing under the vibrating needle, and afterward hardens as it dries.

I prefer to place the material upon the surface of a thin flexible strip, which is fed by suitable mechanism from a drum on one side of the apparatus to one on the other side, passing under the vibrating needle, and before reaching such needle coming in contact with the solvent. Suitable materials for the purpose are celluloid, glue, wax, molasses, pitch, asphalt, or various glutinous or resinous substances, or two or more of such substances in combination. A compound which I have found especially advantageous is one of celluloid mixed with a smaller quantity of molasses and beeswax, the celluloid and beeswax being dissolved with ether or other suitable solvents before mixing. This mixture I then spread evenly on a strip of paper or other suitable surface and allow it to dry hard, and then finish it with as smooth a surface as possible. Another combination which I have used to great advantage is one of glue, molasses, and wax, applied in a similar manner to that just described. This forms a particularly smooth and glossy surface, and prevents largely the harsh grating sound, which is an objection when tin-foil is used.

I employ solvents suitable for the particular material used. For instance, with celluloid I may use ether, with glue, and water, which may be heated, or with other materials alcohol, ammonia, or acetic acid, the proper solvent being employed for the material used, as will be readily understood.

Convenient apparatus for carrying my invention into effect is illustrated in the accompanying drawings.

Figure 1 illustrates a form of apparatus in which the strip is passed through a bath of the solvent. Fig. 2 illustrates a form in which the solvent is applied by means of a brush, and Fig. 3 is a view of a portion of the strip.

In Fig. 1, A represents a suitable inclosing box or case. B is a vessel containing the solvent. C is the mouth-piece or ear-piece, *a* the diaphragm, and *b* the vibrating point or needle. D is a spool or drum carrying the strip *c*, on which the sound-vibrations are to be recorded. This is a strip of paper or other suitable flexible material of sufficient strength for the purpose, and is covered with the soluble substance *d*, Fig. 3, such as above described. This strip passes over a roller, *e*, and then over the two rollers *f f* in the vessel B, under the surface of the liquid, then over the roller *g*, which brings it directly under the needle, and, finally, to the receiving drum or spool E, on which it is wound, this drum being revolved by a spring or any suitable motor, as indicated, so as to move the strip when in operation continuously along under the needle. As the strip passes through the solvent its surface is softened by the action thereof, so that it readily receives the impressions of the needle as it vibrates in accordance with sound-vibrations projected against the diaphragm. The drum E is placed at a sufficient distance, so that the surface dries before the strip is wound thereon. The surface of course hardens as it dries, so that the impressions remain permanently thereon.

The drums are preferably removable, so that the drum, with the record upon it, may be removed, and such record may be reproduced by placing the drum in a similar machine, of course with the solvent omitted, and passing it under the needle.

In the form shown in Fig. 2 the strip *c* passes from the spool D to the spool E under the needle, as before. The vessel and the rollers therein are omitted, and the strip passes directly from a roller, *h*, supported on the side of the case to the roller *g* under the diaphragm. Between the rollers *h* and *g* a brush, *i*, rests lightly on the top of the strip. In this case this brush takes the place of the vessel of Fig. 1 as the receptacle for the solvent. A vessel, *k*, is supported by the top of the box, which vessel contains the solvent. From an aperture in the bottom of the vessel a porous body, *l*, which is preferably a mass of fibrous or spongy material—as wicking or sponge—hangs down and rests on the brush *i*, whereby the brush is kept constantly provided with the solvent. The traveling strip is therefore continually moistened with the liquid as it moves and reaches the needle, with its surface in the desired soft and impressible condition. I prefer to provide the brush with a handle, *m*, pivoted at *n* and passing through a slot in the side of the case, whereby when the machine is not in use, or when it is in use for reproducing sound, the strip may be removed from contact with the solvent by pressing down on the projecting handle. A spring-catch, *o*, is preferably provided for holding the brush away from the strip. The drum E is turned by a suitable motor, as before.

I do not claim herein the method of recording sounds by softening the recording medium, passing it through the recording-instrument while in such softened condition, and then allowing it to harden to set the impressions, since this is claimed in my prior application, filed September 11, 1886.

What I claim is—

1. The method herein described of making a permanent record of vibrations, which consists in softening a body of material by a chemical solvent, passing the same through the recording-instrument while it is in a softened condition, and then allowing it to harden.

2. The method of recording phonetic vibrations, which consists in covering a strip of material with a substance capable of being softened by a chemical solvent, subjecting said substance to the action of such solvent, passing it in its softened condition under the vibrating point of a phonograph, and afterward allowing it to harden to fix the phonogram, substantially as set forth.

This specification signed and witnessed this 13th day of June, 1887.

GEORGE H. HERRINGTON.

Witnesses:

RICHARD B. REILAY

F. J. ARNOLD.

Correction in Letters Patent No. 397,856.

It is hereby certified that in Letters Patent No. 397,856, granted February 12, 1889, upon the application of George H. Herrington, of Wichita, Kansas, for an improvement in "Method of Recording Speech," an error appears in the printed specification requiring the following correction, viz: On page 1, in line 53, the word "and" should be stricken out; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 19th day of February, A. D. 1889.

[SEAL.]

D. L. HAWKINS,
Assistant Secretary of the Interior.

Countersigned:

BENTON J. HALL,
Commissioner of Patents.

(No Model.)

C. A. RICHARDSON.

RUDDER HOLDER AND SUPPORT.

No. 299,265. Patented May 27, 1884.

Fig. 1.

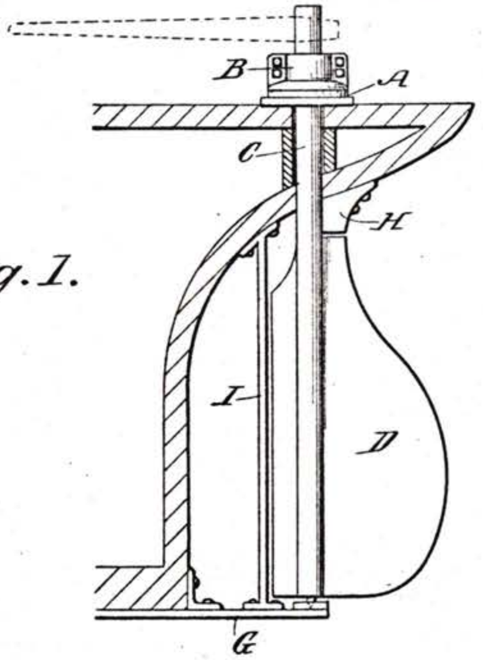


Fig. 2.

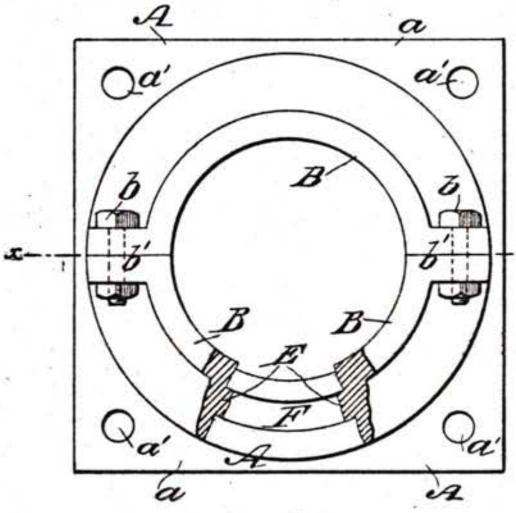
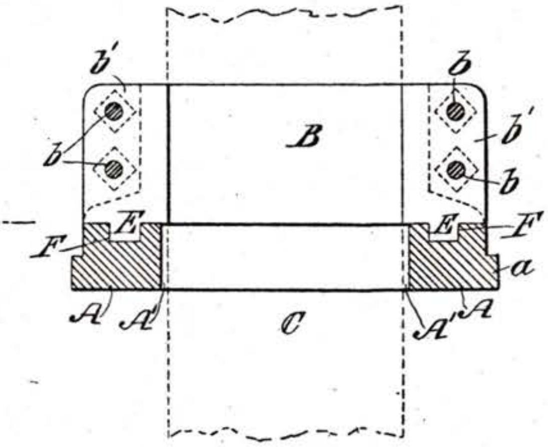


Fig. 3.



WITNESSES:

John C. Deemer

C. Sedgwick

INVENTOR:

C. A. Richardson

BY Munn & Co

ATTORNEYS.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

CHARLES A. RICHARDSON, OF ALPENA, MICHIGAN.

RUDDER HOLDER AND SUPPORT.

SPECIFICATION forming part of Letters Patent No. 299,265, dated May 27, 1884.

Application filed February 20, 1884. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. RICHARDSON, of Alpena, in the county of Alpena and State of Michigan, have invented a new and Improved Rudder Holder and Support, of which the following is a full, clear, and exact description.

The object of my invention is to provide a simple, inexpensive, and durable holder and support for fitting the rudder to a ship or boat.

The invention consists in a bed-plate fixed to the vessel and a collar fixed on the rudder-post, said bed-plate and collar being tongued and grooved together to insure a firm hold of the rudder to its place, and permit easy movement of the rudder in steering the vessel, and whereby also the rudder-post and its casing are protected from wear, and leakage around the post is prevented, and the lower bearing-shoe of the rudder is or may be relieved of downward strain by the weight of the rudder, all as hereinafter fully described and claimed.

Reference is to be had to the accompanying drawings, forming part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of part of the stern of a ship or boat with my improved rudder holder and support shown as applied to use. Fig. 2 is an enlarged plan view of the holder and support, with the rudder-post clamp-ring partly broken away; and Fig. 3 is a sectional elevation on the line *x x*, Fig. 2, and with the rudder-post shown in part and in dotted lines.

My improved holder and support need consist of but few parts, a base or bed plate, A, having a flange, *a*, through holes *a'* of which any suitable bolt or other fastenings pass to secure the holder to the deck of the ship or boat, and a two-part flanged collar, B, having its halves fastened together by suitable bolts, *b*, passed through the flanges *b'*, so as to clamp the collar B firmly and immovably upon the post C of the vessel-rudder D. The bed-plate A and collar B are tongued and grooved together, as shown clearly in Figs. 2 and 3, in which the tongue E is shown as formed upon the lower edge of the collar B, and entering a groove, F, in the top edge or face of the bed-plate, which is the preferred arrangement; but the tongue may be formed on the bed-plate and the groove in the collar, if desired, as either construction will permit the collar B to turn freely in and be guided by the bed-plate A as the collar is swung horizontally in turning the rudder D from side to side in steering the vessel. I make the hole A' through the bed-plate A larger than the hole through the collar B, so that the rudder-post C, will not rub and chafe or wear against the bed-plate, as will be seen in Fig. 3.

In applying my improvement, the rudder D is stepped or pivoted at the lower end in the shoe G, and the bed-plate A is placed around the rudder-post C and secured firmly to the vessel's upper deck, or to any suitable support below the deck to accommodate the position of the steering-gear, and the collar B is clamped to the post C and seated on or in the bed-plate A, with the tongue-and-groove joint fitted closely together and water-tight, so that all leakage into the vessel from around the rudder-post will be prevented. Any approved chock-block, H, is then applied on the vessel's stern, against which block a shoulder on the rudder may rise to prevent the rudder from lifting out of its bearings in the shoe G or other support, which may or may not be braced by an outboard strut or hanger, I, as desired. Any suitable contrivances may be used to give the rudder D its lower end bearing, and to prevent it from rising therefrom. The bed-plate A and collar B may each be formed in one or more pieces; but the construction shown is preferred.

It is evident that with my improved holder and support applied the rudder cannot break loose, and will be held to the vessel even if the shoe G be carried away, and the rudder-post will be held by the tongue-and-groove joint of the bed-piece and collar, so as to work smoothly and freely at all times, and the weight of the rudder may be wholly or mainly carried by the bed-piece and collar A B to relieve the shoe G of downward strain.

If desired, an iron band or strap may be fitted loosely around the post C above the collar B, and to be held to the bed-plate A or the vessel's deck by bolts passed through arms of the band, and so that the latter may aid block H in preventing a rise of the rudder; or this upper band or strap may be used instead of the block H, if preferred.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the rudder-post C and its fixed collar B, of the bed-plate A, fixed to the vessel, tongued and grooved to the collar to enable the collar to turn upon it, and having an aperture, A′, of such diameter as to isolate said plate or support from the rudder-post, substantially as and for the purpose set forth.

2. The combination, with the rudder-post C and its fixed collar B, of the bed-plate A, fixed to the vessel, and tongued and grooved to the collar to enable the collar to turn upon it, said plate also having an aperture, A′, of such diameter as to isolate it from the rudder-post, and the collar having a flange covering the upper surface of the plate, substantially as and for the purpose set forth.

3. The combination of the rudder-post C, collar B, fixed to the latter, the bed-plate A, fixed to the vessel, and tongued and grooved to the plate to enable the collar to turn upon it, said plate having an aperture, A′, of such diameter as to isolate it from the rudder-post, the shoe G, and block H, substantially as and for the purpose set forth.

CHARLES A. RICHARDSON.

Witnesses:
VICTOR C. BLANCHARD,
SAML. H. PANGBORN.

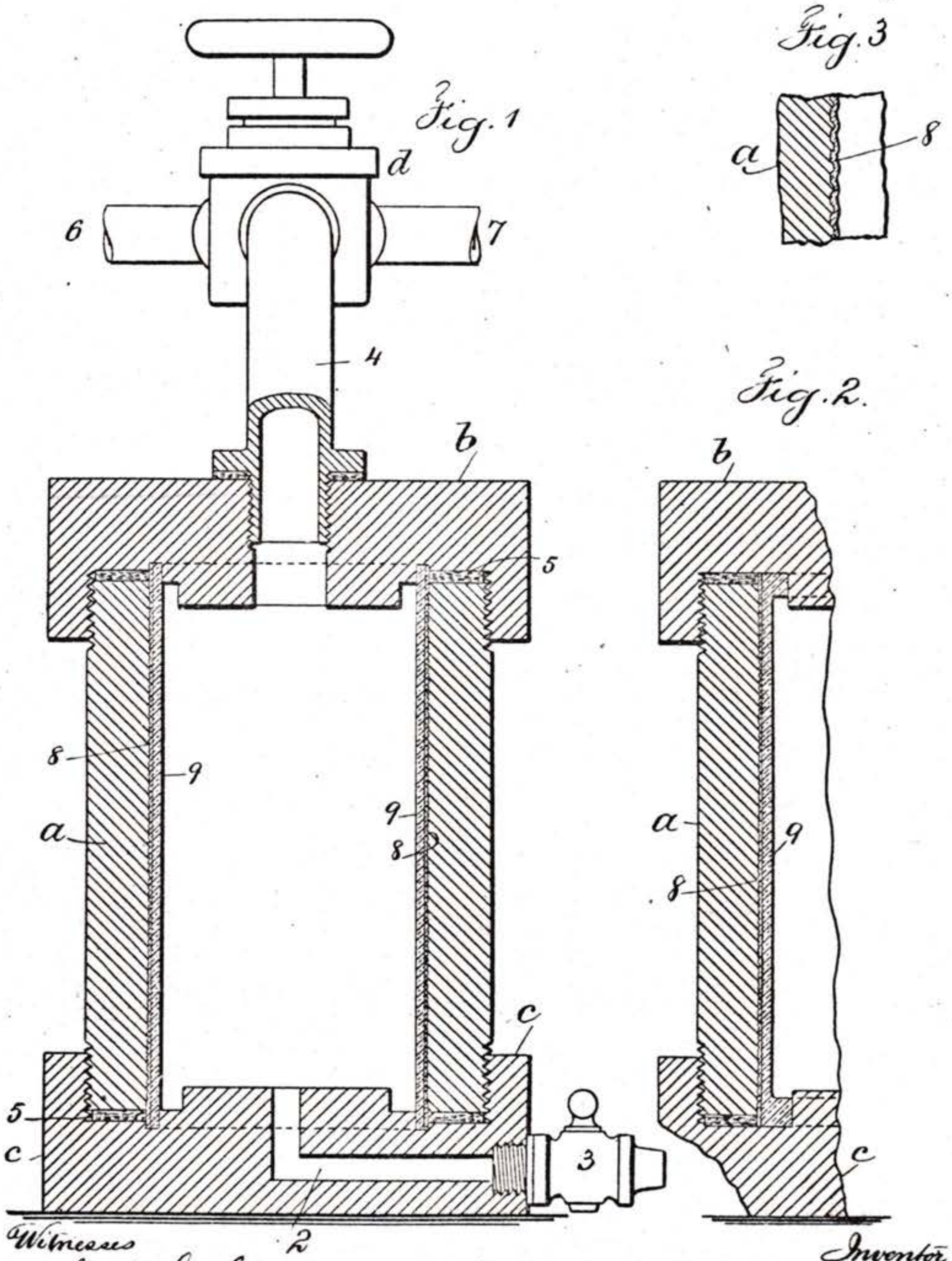
No. 689,408. Patented Dec. 24, 1901.

A. N. PETIT.

METHOD OF MAKING SOUND RECORD CYLINDERS.

(Application filed Dec. 8, 1900.)

(No Model.)



Witnesses
Chas. H. Smith
J. Staib

Inventor
Ademor N. Petit.
Per L. W. Serrell & Son
attys

UNITED STATES PATENT OFFICE.

ADEMOR N. PETIT, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND
ALBERT O. PETIT, OF NEWARK, NEW JERSEY.

METHOD OF MAKING SOUND-RECORD CYLINDERS.

SPECIFICATION forming part of Letters Patent No. 689,408, dated December 24, 1901.

Application filed December 8, 1900. Serial No. 39,127. (No specimens.)

To all whom it may concern:

Be it known that I, ADEMOR N. PETIT, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented an Improvement in the Method of Making Duplicate Sound-Record Cylinders, of which the following is a specification.

Heretofore matrices have been made of original sound-records, and duplicates have been prepared from such matrices; and my present invention relates to the method of making duplicate sound-record cylinders from matrices of an original record, and the same is an improvement upon the method set forth in my application, Serial No. 25,386, filed July 31, 1900.

In carrying out my present invention I apply to the matrix-surface a material in a fluid state, preferably by a brush and centrifugal motion, and which material as the same dries and sets forms a skin or film upon the surface of the matrix, which film takes the impression of the matrix in its surface and serves for the surface of the duplicate sound-record cylinder. As a material for coating the surface of the matrix and forming the film I prefer to employ celluloid, gelatin, lac, glue, gum, collodion, or similar material, and this may be applied to any desired thickness in a fluid state. I employ a foundation or cylindrical shell fitting closely within the said film, and this foundation or shell is in whole or part of material adapted to be softened and connected by heat and pressure through adhesion to the duplicate sound-record film. I prefer that the material of the foundation or shell should be impregnated with or have a surface of the same material as that composing the film, so that connection between the two by heat and pressure may be in the form of a cementing action.

I prefer to employ an apparatus into which steam may be introduced under considerable pressure for the purpose of heating and softening the foundation or cylindrical shell and at the same time expanding the same sufficiently so as to form an intimate contact and adhesion with the film, and I propose as soon as sufficient time has elapsed to insure a connection of the foundation and film in this manner to replace the steam under pressure by air under pressure and to chill the matrix, so as to cool and set the parts and thereafter to maintain the pressure of air for a sufficient time until the connected film and foundation are thoroughly set and cooled, after which the same is to be removed from the matrix.

In the drawings, Figure 1 is a vertical section of a device adapted for the carrying out of my improved method. Fig. 2 is a partial vertical section representing a modification, and Fig. 3 is a detached vertical section showing part of a connected matrix and film upon a larger scale.

The improved apparatus for carrying out the method and making the article is preferably composed of a matrix *a*, a head *b*, connected by a threaded flange to one end of the said matrix, a base *c*, connected also by a threaded flange to the other end of the said matrix in a similar manner, there being packings 5, preferably, between the ends of the matrix and the head and base, so as to insure a tight joint. The base *c* is preferably provided with an exit-opening 2 and an escape-cock 3, and the head is preferably provided with a pipe 4, and a three-way cock *d* connected to the pipe 4, and from the opposite side of which there is a steam-pipe 6 and a pipe 7 for compressed air.

8 represents the film duplicate sound-record, and 9 the foundation or cylindrical shell. I prefer to employ within the head and base annular grooves to receive the foundation ends, with the object of insuring the steam and air pressure doing the work and preventing the same getting in between the foundation and skin.

With the matrix separated and disconnected in relation to the head and base, and which matrix is formed in any manner well known in the art, the inner surface of the matrix is to be coated to any desired thickness by a material in a fluid state. This material may be applied by a brush or centrifugal motion, or both, so as to impart to the matrix-surface an even homogeneous film until the desired thickness is obtained; when the same is allowed to set or dry to yield an impression of the matrix. The film thus obtained is firm, dense, and yet flexible, and is preferably composed of such materials as have hereinbefore been referred to.

The foundation 9 or cylindrical shell is adapted to fit closely within the film 8, and this foundation may be made with integral inturned ends or not, as this forms no necessary part of the invention. I have, however, shown in Fig. 1 a foundation without inturned ends, and in Fig. 2 a foundation with inturned ends as the method of the present invention is equally applicable to both forms of foundation. This foundation is preferably made of material adapted to be softened and connected by heat and pressure through adhesion to the duplicate sound-record film, and the material of the foundation is preferably of such a nature as to carry a substance of a similar nature to that composing the film either by being impregnated with or by having an applied surface coating of such material, so that the connection formed between the two by heat and pressure may be a cementing action. The material of the foundation may be and preferably is the same as that of the film, but loaded with pigment to give body and cheapness.

After the film 8 has been made and the foundation 9 inserted within the matrix the head *b* and the base *c* are connected to the matrix, as shown, and the escape-cock 3 closed. Steam is then admitted by the pipe 6 and the three-way cock *d* and pipe 4 into the cavity or space within the matrix and within the said foundation. The heat softens the foundation or cylindrical shell and the pressure expands the same. The heat also softens the film so that the surface of the film and the surface of the expanding foundation come into intimate contact and connection and a cementing action is produced between the two, because of the substances of similar nature, by the heat and pressure, so that they are connected by adhesion. After sufficient time has elapsed for this operation I prefer to close off the steam and to replace the same by air under pressure and thereafter to submerge the matrix into a bath of cold water, which suddenly chills the matrix, the film, and the foundation, while the pressure is maintained within the same. I thereafter remove the matrix from the water or cooling mixture. In substituting the air under pressure for the steam under pressure I turn the three-way cock and admit compressed air and open the escape-cock to blow out the steam. After the steam has been blown out the escape-cock 3 is closed and the air-pressure maintained within the matrix until the parts are so thoroughly cooled and set that it is perfectly safe to close off the compressed air, separate the parts, and take out the duplicate sound-record cylinder complete.

If the film 8 is composed of celluloid, the foundation 9 should either be impregnated with a solvent of celluloid or should have an applied surface of celluloid or a solvent adhering thereto, so that the same, when softened with the film and forced by pressure into connection with the materials, will join and form a homogeneous connected or cemented mass, and in any event, whatever material the film may be composed of, the backing or foundation should carry a substance of a similar nature by being either impregnated with the same or having an applied surface coating of such material, which under heat and pressure will combine or commingle with the material of the skin so as to form a homogeneous or permanently-connected mass.

I claim as my invention—

1. The method herein specified of making duplicate sound-record cylinders, consisting in forming upon the surface of a matrix a film of material applied thereto, inserting within the matrix and film a foundation or cylindrical shell closely fitting the same and which shell carries a substance of a similar nature to that composing the film applying heat and pressure within the foundation and matrix to soften the material of the foundation or cylindrical shell and that of the film and to force the same into intimate contact and adhesion, and maintaining the pressure until the parts set and cool, substantially as set forth.

2. The method herein specified of making duplicate sound-record cylinders, consisting in forming upon the surface of a matrix a film of material applied thereto, inserting within the matrix and film a foundation or cylindrical shell closely fitting the same and which shell carries a substance of a similar nature to that composing the film, applying heat and pressure within the foundation and matrix to soften the material of the foundation or cylindrical shell and that of the film and to force the same into intimate contact and adhesion, and chilling the matrix and the connected film and foundation to set and cool the parts and maintaining the pressure during the chilling and until the operations are fully completed, substantially as set forth.

3. The method herein specified of making duplicate sound-record cylinders, consisting in forming upon the surface of a matrix a film of material applied thereto, inserting within the matrix and film a foundation or cylindrical shell closely fitting the same and which shell carries a substance of a similar nature to that composing the film, applying pressure and heat within the foundation and matrix to soften the material of the foundation or cylindrical shell and that of the film and to force the same into intimate contact and adhesion, displacing the material producing the heat and pressure by air or similar fluid under pressure and chilling the matrix by immersing the same in a cooling material which at the same time chills the connected film

and foundation, removing the same from the chilling mixture, and maintaining the pressure thereafter until the parts are thoroughly set and the finished sound-record ready for removal, substantially as set forth.

4. The method herein specified of making duplicate sound-record cylinders consisting in forming upon the surface of a matrix a film of material applied thereto, placing within the film a permanent base or backing, applying heat and pressure to soften the parts and force them into intimate contact and adhesion, substantially as specified.

5. The method herein specified of making duplicate sound-record cylinders consisting in uniting a permanent base or backing to a film-surface and impressing a record-matrix into said film-surface by the same pressure, substantially as specified.

6. The method herein specified of making duplicate sound-record cylinders consisting in bringing a prepared film-surface into opposition to a contained and substantially contacting permanent base or backing, applying heat to soften the parts and a pressure that is maintained as desired to unite the parts and insure the impressing of the film-surface by a record-matrix, substantially as specified.

Signed by me this 3d day of December, 1900.

ADEMOR N. PETIT.

Witnesses:
GEO. T. PINCKNEY,
S. T. HAVILAND.

No. 657,956. **Patented Sept. 18, 1900.**

A. N. PETIT.

GRAPHOPHONE CYLINDER.

(Application filed Nov. 15, 1899.)

(No Model.)

Fig. 1.

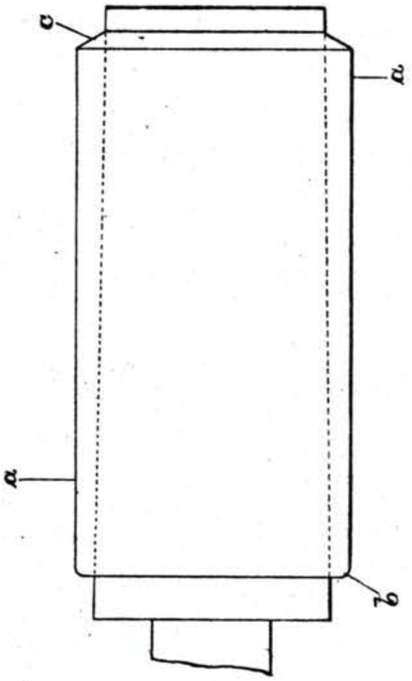
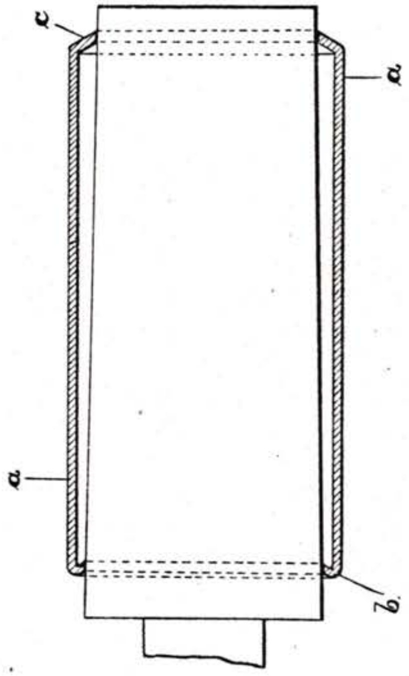


Fig. 2.



Witnesses
A. H. Serrell
Chas H. Smith

Inventor
A. N. Petit
per
L. W. Serrell & Son
Att'ys.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ADEMOR N. PETIT, OF NEWARK, NEW JERSEY.

GRAPHOPHONE-CYLINDER.

SPECIFICATION forming part of Letters Patent No. 657,956, dated September 18, 1900.

Application filed November 15, 1899. Serial No. 737,016. (No model.)

To all whom it may concern:

Be it known that I, ADEMOR N. PETIT, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Record-Cylinders for Phonographs, Graphophones, and Similar Instruments, of which the following is a specification.

As heretofore constructed, records or cylinders for phonographs, graphophones, and similar machines have been made from a preparation of wax or similar material. These records have been of considerable thickness and appreciable weight. They have been made with a taper opening through the center to receive and fit upon the taper mandrel of the machine. These records have been of a delicate nature, because they were easily broken and the surface was readily marred or disfigured if accidentally brought in contact with any harder substance. Consequently they had to be very carefully handled, and special devices have been made for receiving, storing, and carrying the said records from place to place.

The object of my invention is to overcome these difficulties.

My invention is a new article of manufacture; and it consists of a cylinder or record of celluloid in which the respective ends are bent inward, so as to leave the opening of a diameter to fit upon the taper mandrel of the machine, and which openings at the ends of the cylinder are of less diameter than the interior diameter of the cylinder. These cylinders are light and strong and the surface is hard and they do not have to be handled with any particular care, and special devices do not have to be provided for storing or carrying about the same.

In the drawings, Figure 1 is an elevation of a cylinder upon the mandrel, and Fig. 2 is an elevation of the mandrel and longitudinal section of the cylinder or record.

The cylinder or record a is formed from a tube of celluloid or similar material of an external diameter agreeing with the diameter of the cylinders or records already in use and upon the market. The tube is of sufficient thickness for strength, but is withal exceedingly light, and the interior diameter is somewhat greater than the diameter of the mandrel at any point. In order that the tube may fit upon the taper mandrels in use and be concentric therewith, the respective ends are softened and are bent inward. The end b is inwardly curved and of the greatest diameter, and the end c is bent inward in a tapering form, preferably, and is of the lesser diameter. I prefer to bend the ends in in such a manner that the cylinder or record so formed slips readily upon the mandrel of the phonograph, graphophone, or other machine and when in place is held with sufficient friction to prevent any possibility of the cylinder or record slipping on the mandrel. The cylinder or record is produced of one piece of material, the ends being integral and bent inward, preferably of the form shown in the longitudinal section. These cylinders possess lightness and strength and are comparatively inexpensive, and they are not readily broken, and there is a great saving in weight over and above cylinders of ordinary construction.

In my application for Letters Patent, Serial No. 734,933, filed October 27, 1899, I have described the method of and materials for treating the surface of cylinders or record-blanks of this character, so that the record may be impressed upon the surface of the cylinder in the same manner as the record is impressed upon the wax surface of the ordinary cylinder.

I claim as my invention—

1. As a new article of manufacture, a cylinder or record for phonographs, graphophones or similar machines, formed from a tube with the ends integral and bent inward and provided with openings of different diameters, so that they fit upon the taper mandrel of the machine, substantially set forth.

2. As a new article of manufacture, a cylinder or record for phonographs, graphophones or similar machines of celluloid and formed from a tube with the ends integral and bent inward and provided with openings of different diameters so that they fit upon the taper mandrel of the machine, substantially as set forth.

Signed by me this 13th day of November, 1899.

ADEMOR N. PETIT.

Witnesses:
GEO. T. PINCKNEY,
E. E. POHER.

No. 689,118. Patented Dec. 17, 1901.

A. N. PETIT.

METHOD OF MAKING DUPLICATE SOUND RECORDS FOR PHONOGRAPHS.

(Application filed Mar. 23, 1901.)

(No Model.)

Fig. 1.

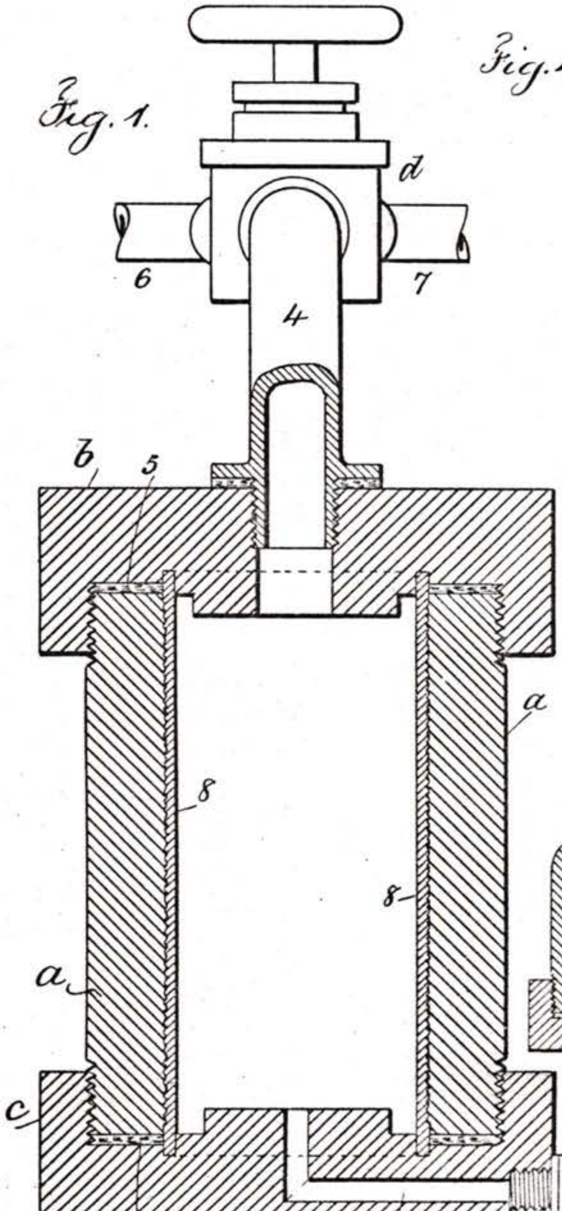


Fig. 4.

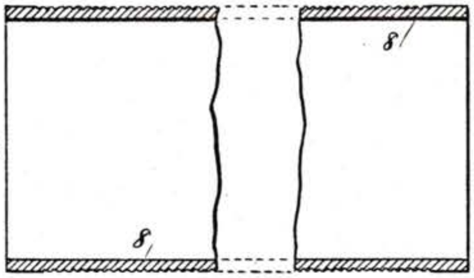


Fig. 5.

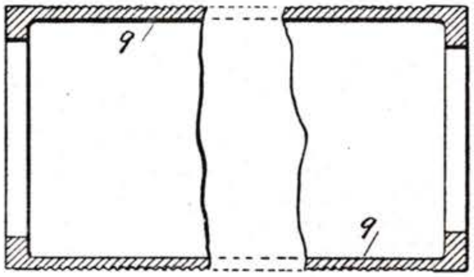


Fig. 3

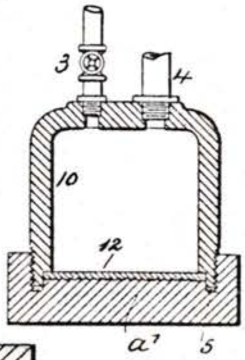
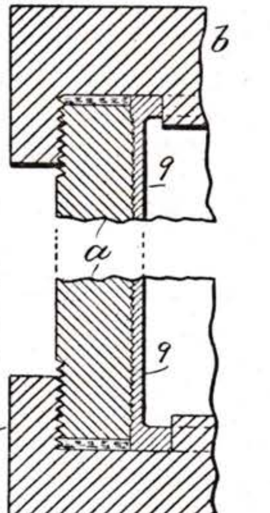


Fig. 2.



Witnesses

Chas H. Smith

J Staib

Inventor

Ademor N. Petit

per L. W. Serrell & Son
attys

UNITED STATES PATENT OFFICE.

ADEMOR N. PETIT, OF NEWARK, NEW JERSEY.

METHOD OF MAKING DUPLICATE SOUND-RECORDS FOR PHONOGRAPHS.

SPECIFICATION forming part of Letters Patent No. 689,118, dated December 17, 1901.

Application filed March 23, 1901. Serial No. 52,472. (No model.)

To all whom it may concern:

Be it known that I, ADEMOR N. PETIT, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Methods of Making Duplicate Sound-Records for Phonographs and Similar Machines, of which the following is a specification.

Heretofore matrices have been made of original sound-records, and duplicates have been prepared from such matrices; and my present invention relates to the method of making duplicate sound-records from matrices of an original or master record.

In carrying out my invention I employ a blank formed from such materials or compositions as celluloid, gelatin, lac, glue, gum, collodion, or similar materials. The blank may be a disk or cylinder, and when the blank is in the form of a cylinder it is immaterial whether the same be provided with inturned ends or flanges or not, as this forms no necessary part of the present invention. The surface of this blank contains substances acting not only to soften the same, but otherwise to alter and change the character of the surface and to rearrange or change the molecular character of the material. This condition of the surface may be brought about in either one of two ways, namely: The surface may be treated by a mixture of a solvent for the material of which the blank is formed, together with a fatty material, or the fatty material may be added to the solvent and base in the manufacture of the blank. In the first instance the surface only is affected, permeated, and changed, while in the second instance the entire blank is affected and permeated. The preparation of the blank in the latter instance is advantageous over the former instance only in the point of cheapness, the result being to all intents and purposes absolutely the same. In the method employed by me this blank is placed against a matrix, which it closely fits, and in a suitable apparatus heat and pressure are employed to soften the blank and expand the same and also to force its surface into minute and intimate contact with the surface of the matrix. The heat passes through the blank from within outward and softens the same, and with the application of pressure to expand the blank and to force its surface into intimate contact with the matrix the softened surface will completely fill all of the delicate interstices and conformations of the matrix, imparting to the surface of the blank a positive of the negative surface of the matrix. Where the surface only has been treated, the same is softened to a slightly-greater extent than the other portions of the blank, it being especially advantageous that the surface should be caused to closely conform to the interstices of the matrix. Where the blank is of celluloid or collodion, I prefer to employ for the treatment of the same a solvent and fatty matter, as set forth in the United States patent granted to me December 4, 1900, No. 662,981. Where the blank is of gelatin, lac, glue, gum, or other similar material, a substance comprising a solvent and other suitable material is to be employed that is capable of treating the blank to alter and change its character or molecular structure in a manner similar or substantially identical with the operation performed by the solvent and fatty matter upon the blank where the same is formed of celluloid. I do not, however, limit myself in the present instance to the materials employed for this purpose nor to the fact of the blank being in the form of a disk or of a cylinder, as the method is equally applicable to either a disk or cylinder.

In the drawings, Figure 1 is a vertical section of an apparatus adapted for the carrying out of my improved method. Fig. 2 is a partial vertical section representing a slight modification. Fig. 3 is a vertical section representing a further modification, and Figs. 4 and 5 are broken sectional views of the blank in the form of a duplicate sound-record cylinder.

The apparatus for carrying out the method herein described and forming the duplicate sound-record cylinder preferably comprises a matrix *a*, which matrix may be made in any manner well known in the art, a head *b*, connected by a threaded flange to one end of the said matrix, and a base *c*, connected also by a threaded flange to the other end of the said matrix in a similar manner, there being packings 5 preferably between the ends of the matrix in the inner surface of the head and base, so as to insure a tight joint. The base *c* is preferably provided with an exit-opening 2 and escape-cock 3, and the head is preferably provided with a pipe 4, connecting with a central opening through the head, and a three-way cock *d*, connected to the pipe 4, and from the opposite side of which there are a steam-pipe 6 and a pipe 7 for compressed air.

In Figs. 1 and 4, 8 represents a duplicate sound-record cylinder with plain ends, and 9 in Figs. 2 and 5 represents a duplicate sound-record cylinder with inturned ends or flanges. I prefer to employ within the head and base in the apparatus annular grooves to receive the ends of the foundation, with the object of insuring the steam and air pressure doing the work and preventing the same getting in between the cylindrical blank and the surface of the matrix.

The modification Fig. 3 illustrates the application of my improved method to the treatment of a disk blank. In this modification the matrix *a′* forms the bottom portion of a body, in which 10 forms the upper or cup-shaped portion, to which the matrix is attached, preferably, by a screw-joint with a washer, there being in this case also an annular groove in the base of the portion 10 to receive the edges of the disk blank 12.

The blank, whether a disk or cylinder, prepared in the manner hereinbefore set forth is to be placed in proximity to the matrix and the parts of the apparatus connected and steam admitted by the pipe 6, three-way cock, and pipe 4 into the space or cavity within the apparatus. The disk blank lies against the surface of the matrix, and the blank cylinder fits closely within the matrix. The edges of the disk blank are held in the annular grooves, and the edges of the cylindrical blank are also held in the annular grooves, and the cylinder may be provided with inturned ends or not. The heat of the steam admitted into the cavity or space within the apparatus softens the blank from the back outward, and the pressure of the steam tends not only to expand the blank, but to force the same against the matrix and cause the softened surface to closely fill all the delicate interstices of the matrix and to accurately conform to the negative record of sound thereon. Where the surface only of the blank is treated, the heat of the steam has a greater softening action thereon than on the other portions forming the blank, and this facilitates the material of the blank closely conforming to the negative of the matrix.

Where the entire blank is treated, the action is the same as where only the surface is treated; but the heating action consumes slightly less time, because in this instance the blank is slightly softer in its entire composition than where the surface only is treated. After sufficient time has elapsed for the action of the heat upon the blank the steam is closed off and compressed air admitted, the escape-cock 3 being preferably opened for a short period to permit of the escape of the steam remaining in the apparatus.

The pressure of compressed air is maintained to hold the blank into intimate contact with the surface of the matrix until the same cools and sets and is sufficiently hard to warrant the removal. This cooling action is advantageously facilitated by submerging the apparatus into a bath of cold water or subjecting the same to external cold of a dry character. The action of the cold is to suddenly chill the matrix and blank and cause a slight contraction of the blank from the matrix. After the parts are cooled and the duplicate sound-record, formerly a blank, is sufficiently set the compressed air is turned off and the parts of the apparatus are separated and the duplicate sound-record removed.

The method herein described is applicable alike to a blank whether the same be in the form of a disk or a cylinder and whether the same be of celluloid or of other suitable material, as hereinbefore set forth.

I do not limit myself either to the form of the blank or to the materials of which the same is composed.

I claim as my invention—

1. The method herein specified of making duplicate sound-records consisting in taking a blank having a surface treated by substances acting not only as solvents to soften the same, but to alter and change the molecular character thereof, inserting said treated blank into a suitable apparatus and upon a matrix embraced therein, applying in the apparatus and upon the blank heat and pressure to soften the blank and its surface and to force the same into intimate contact with the surface of the matrix and maintaining the pressure until the blank is set and thereafter removing the same from the apparatus and matrix, substantially as set forth.

2. The method herein specified of making duplicate sound-records, consisting in taking a blank having a surface treated by substances acting not only as solvents to soften the same but to alter and change the molecular character thereof, inserting said treated blank into a suitable apparatus and upon a matrix embraced therein, applying within the apparatus and upon the blank heat and pressure to soften the blank and its surface and to expand the same into intimate contact with the surface of the matrix and maintaining the pressure and applying cold to the apparatus to cause the duplicate sound-record to set, and thereafter removing the same from the apparatus and matrix, substantially as specified.

3. The method herein specified of making duplicate sound-records, consisting in taking a blank treated by a solvent and a fatty matter to soften the surface and to alter and change the molecular character thereof, inserting said treated blank into an apparatus and against the surface of a matrix forming

a part thereof, applying within the apparatus and upon the blank heat and pressure to soften the blank and its surface and to expand and force the same into intimate contact with the surface of the matrix and maintaining the pressure until the same is set, and thereafter removing the same from the matrix, substantially as set forth.

4. The method herein specified of making duplicate sound-records, consisting in taking a blank treated by a solvent and a fatty matter to soften the surface and to alter and change the molecular character thereof, inserting said treated blank into an apparatus and against the surface of a matrix forming a part thereof, applying within the apparatus and upon the blank heat and pressure to soften the blank and its surface and to expand and force the same into intimate contact with the surface of the matrix and maintaining the pressure and applying cold to the apparatus to cause the duplicate sound-record to set and thereafter removing the same from the matrix, substantially as set forth.

5. The method herein specified of making duplicate sound-record cylinders, consisting in taking a blank cylinder of celluloid in which the surface of the celluloid is treated with a mixture of a solvent and a fatty matter to soften the surface and alter and change the molecular character thereof, placing the treated blank cylinder into a matrix, applying within the matrix and within the treated cylinder of celluloid heat and pressure to soften the celluloid and its treated surface and to expand and force the same into intimate contact with the surface of the matrix to impart from the negative matrix a positive impression to the celluloid cylinder for making a duplicate sound-record, maintaining the pressure within the matrix until the celluloid cylinder is sufficiently set to maintain its shape, and thereafter separating the duplicate sound-record cylinder from the matrix, substantially as set forth.

6. The method herein specified of making duplicate sound-record cylinders, consisting in taking a blank cylinder of celluloid in which the surface of the celluloid is treated with a mixture of a solvent and a fatty matter to soften the surface and to alter and change the molecular character thereof, placing the treated blank cylinder into a matrix, applying within the matrix and within the treated cylinder of celluloid heat and pressure to soften the celluloid and its treated surface and to expand and force the same into intimate contact with the surface of the matrix to impart from the negative matrix a positive impression to the celluloid cylinder for making a duplicate sound-record, maintaining the pressure within the matrix, applying cold to the matrix to cause the duplicate sound-record cylinder to set and thereafter separating the duplicate sound-record cylinder from the matrix, substantially as set forth.

7. The method herein specified of making duplicate sound-record cylinders, consisting in taking a blank cylinder of celluloid treated by a mixture of a solvent and a fatty matter to soften the surface and to alter and change the molecular character thereof, placing the treated blank cylinder into a matrix, applying within the matrix and within the treated blank heat and pressure to soften the celluloid blank and force the same into intimate contact with the surface of the matrix to impart from the negative matrix a positive impression to the celluloid cylinder for making from the blank a duplicate sound-record, maintaining the pressure within the celluloid cylinder until the same is sufficiently set to maintain its shape, and thereafter separating the said duplicate sound-record cylinder from the matrix, substantially as set forth.

8. The method herein specified of making duplicate sound-record cylinders, consisting in taking a blank cylinder of celluloid treated by a mixture of a solvent and a fatty matter to soften the surface and to alter and change the molecular character thereof, placing the treated blank cylinder into a matrix, applying within the matrix and within the treated blank heat and pressure to soften the celluloid blank and to force the same into intimate contact with the surface of the matrix to impart from the negative matrix a positive impression to the celluloid cylinder for making from the blank a duplicate sound-record, maintaining the pressure within the celluloid cylinder and applying cold to the matrix to cause the duplicate sound-record cylinder to set and thereafter separating the said duplicate sound-record cylinder from the matrix, substantially as set forth.

Signed by me this 18th day of March, 1901.

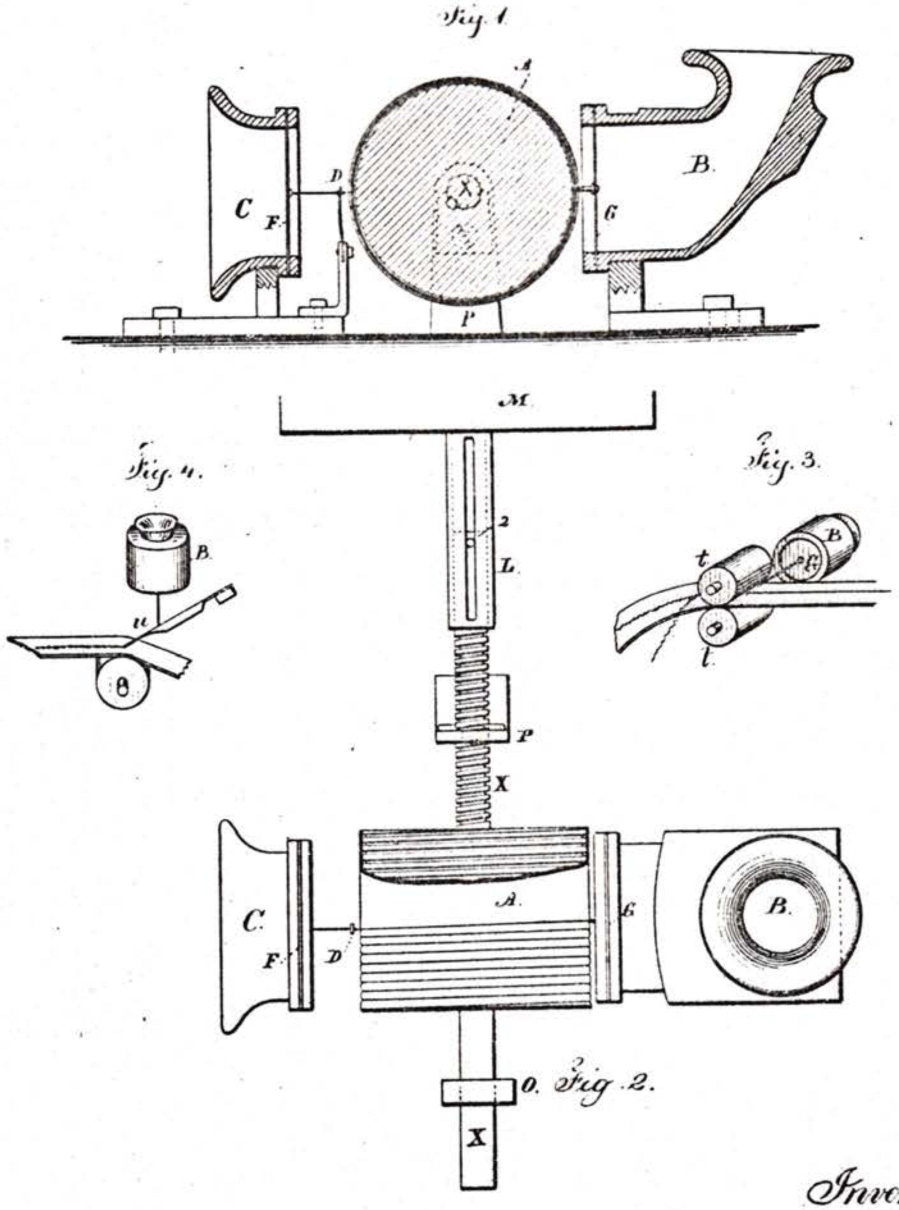
ADEMOR N. PETIT.

Witnesses:

GEO. T. PINCKNEY,
S. T. HAVILAND.

T. A. EDISON.
Phonograph or Speaking Machine.

No. 200,521. Patented Feb. 19, 1878.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. **200,521**, dated February 19, 1878; application filed December 24, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, Y, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L, the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 126, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the transmitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm G, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm; the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

(No Model.)

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

No. 484,582. Patented Oct. 18, 1892.

Fig. 1

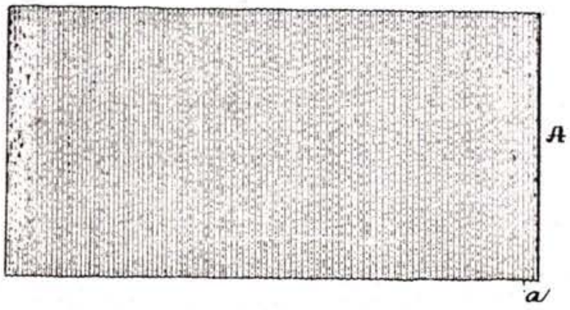


Fig. 2.

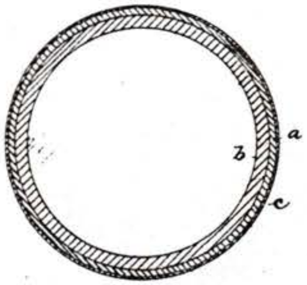


Fig. 3.

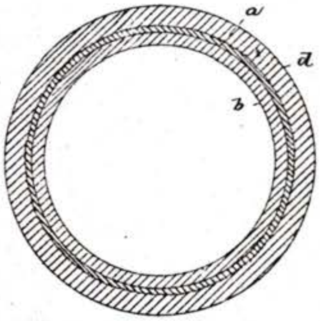


Fig. 4.

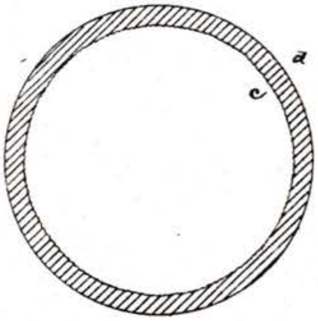


Fig. 5.

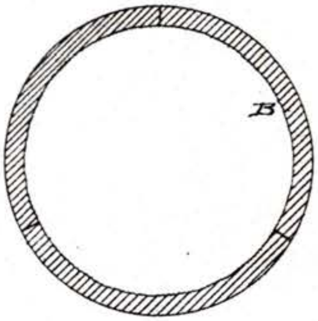


Fig. 6.

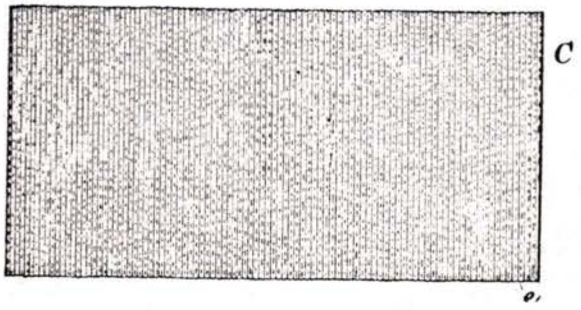
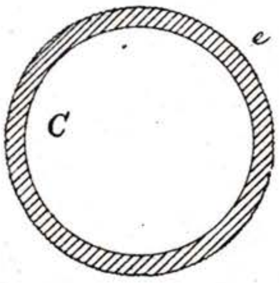


Fig. 7.



Witnesses
E. C. Rowland
William Pelzer

Inventor
Thomas A. Edison,
By his Attorneys Dyer & Seely

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY, ASSIGNOR TO
THE EDISON PHONOGRAPH COMPANY, OF NEW JERSEY.

PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 484,582, dated October 18, 1892.

Original application filed January 5, 1888, Serial No. 259,895. Divided and this application filed January 30, 1888. Renewed March 30, 1892. Serial No. 427,011. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Process for Duplicating Phonograms, (Case No. 751,) of which the following is a specification.

The object I have in view is to produce a practical process for the duplication of phonographic records, so that the new art of phonographic publication can be established. Generally I propose to construct a suitable matrix, preferably in metal, and by its use mold duplicate phonograms with the phonographic records thereon, such phonograms or the surface thereof being preferably constructed of a material too hard for the satisfactory indentation thereof by the phonograph-recorder; but the duplicate phonograms may be made of a softer material. For the construction of the matrix I employ the process of vacuous deposit described in my application, Serial No. 118,942, filed January 28, 1884. The original phonogram is preferably constructed with a surface of wax or a similar material. This is placed in a suitable phonograph and the phonographic record produced thereon. The phonogram so impressed with the phonographic record is placed in a high vacuum, in which an electric arc, continuous or discontinuous, is produced between electrodes of metal or in which metal vapor is otherwise produced. The electric arc produces a vapor of the metal of which the electrodes are composed, which vapor or a metallic vapor otherwise produced within said chamber is deposited on the indented surface of the phonogram, forming a layer of metal thereon, which follows accurately all the indentations of the record, however minute, owing to the highly-comminuted condition of the metal deposited. The phonogram while the deposit is taking place in the vacuum-chamber is revolved slowly by a suitable power-connection, and this is especially necessary when the form of the phonogram is cylindrical, which it preferably is. The vacuous deposit is continued until the layer of metal is sufficiently thick, when the covered phonogram is removed from the vacuum-chamber and is further covered by a more rapid process to give strength and body to the covering. A further covering of metal may be produced by electroplating a metal upon the vacuous deposit in the usual manner of electroplating, or the vacuous deposit may be backed up by casting upon it type-metal or other metal or alloy having a lower fusing-point than the vacuous deposit, or this may be done after electroplating upon the vacuous deposit, or the vacuous deposit may be backed up by a a cement or gum or by plaster-of-paris; but a metal backing is preferred. The material of the original phonogram is then dissolved off of the metal covering, leaving in the case of cylindrical phonograms a hollow metal cylinder or one internally faced with metal, carrying the phonographic record in relief upon its inner surface. This metal cylinder is then split longitudinally by a very thin saw into a number of parts—say, for illustration, three parts—which are suitably mounted upon levers, so that a mold is formed, which can be closed to receive the material to be molded and opened to permit of its being taken out. The duplicate phonograms are produced by means of this mold by pouring therein and preferably around a suitable core placed in the mold suitable substances, such as wax or wax-like material, resin, or plaster-of-paris, the material being preferably too hard to be satisfactorily indented by the phonograph, or the duplicate phonograms may be made by taking sheets of smooth material, like waxed paper or tinfoil, and pressing them upon the surface of the mold by a plunger or otherwise, the sheets being afterward backed up by a wax, resin, or cement. The latter way of making the duplicate phonograms is especially applicable to flat-surface phonograms, although it may be used for phonograms with cylindrical surfaces. The production of the first layer of metal upon the phonograph-record by means of the vacuous deposit has great advantages over doing this by electroplating. In electroplating the wax-surface must first be covered by plumbago or gold-leaf or silver salts reduced by chemical reagents in order to form a conducting basis for the plating. The plumbago and gold-leaf do not bring out the fine vibrations and produce rough reproductions while the silver salts do not run well on the wax surface. The vacuous deposit, however, adheres uniformly to the wax surface and reproduces the record with great perfection.

The invention is illustrated for convenience in connection with a cylindrical phonogram.

In the accompanying drawings, forming a part hereof, Figure 1 is an elevation of an original phonogram; Fig. 2, a cross-section of the original phonogram with a thin vacuous deposit thereon; Fig. 3, a view similar to Fig. 2, with a further backing; Fig. 4, a view the same as Fig. 3, with the original phonogram dissolved out; Fig. 5, a sectional view of the divided mold or matrix; Fig. 6, an elevation of a duplicate phonogram produced by the mold, and Fig. 7 a cross-section of such duplicate phonogram.

A is the original phonogram, having a relatively-soft wax or wax-like surface *a* and the backing of harder material *b*, or it may be entirely of wax. The phonographic record is produced upon the surface *a*. The metallic vacuous deposit is shown at *c*, and the further backing, preferably of metal, is shown at *d*.

B is the divided mold, produced as has been stated and having the phonographic record in relief.

C is the duplicate phonogram, produced by the mold and having a surface *e*, indented with the phonographic record and preferably of harder material than could be practically or satisfactorily indented directly by the phonograph.

My invention herein is limited to constructing the matrix or mold by covering the phonograph-record by a vacuous deposit.

The broad invention of duplicating phonograph-records and of producing matrices for that purpose, not limited to the use of the vacuous deposit as a step in the process of reproducing the phonographic record or constructing a matrix for that purpose, is not claimed herein, such broad subject-matter being covered by an application for patent filed by me January 5, 1888, Serial No. 259,895, of which this specification is a division.

What I claim is—

1. The process of forming a matrix or mold for the duplication of phonographic records, consisting in covering the phonograph-record with a deposit of metal by vaporizing metal in a vacuum in which the record is placed, substantially as set forth.

2. The process of forming a matrix or mold for the duplication of phonographic records, consisting, first, in indenting the original record on a phonogram; second, covering the recording-surface of such phonogram with a deposit of metal by vaporizing metal in a vacuum in which such phonogram is placed, backing up such deposit to give it strength, and then removing the original phonogram, substantially as set forth.

3. The process of forming a matrix or mold for the duplication of phonographic records, consisting, first, in indenting the original record upon a phonogram having a wax-like surface; second, covering the recording-surface of such phonogram with a deposit of metal by vaporizing metal in a vacuum in which such phonogram is placed, backing up such deposit to give it strength, and then removing the original phonogram, substantially as set forth.

4. The process of duplicating phonograms carrying a phonographic record, consisting, first, in indenting the original record upon a phonogram; second, constructing a matrix or mold of such original record by depositing thereon a coating of metal by vaporizing metal in a vacuum in which the record is placed, and, third, producing duplicate phonograms from such matrix, substantially as set forth.

This specification signed and witnessed this 17th day of January, 1888.

THOS. A. EDISON.

Witnesses:
WILLIAM PELZER,
E. C. ROWLAND.

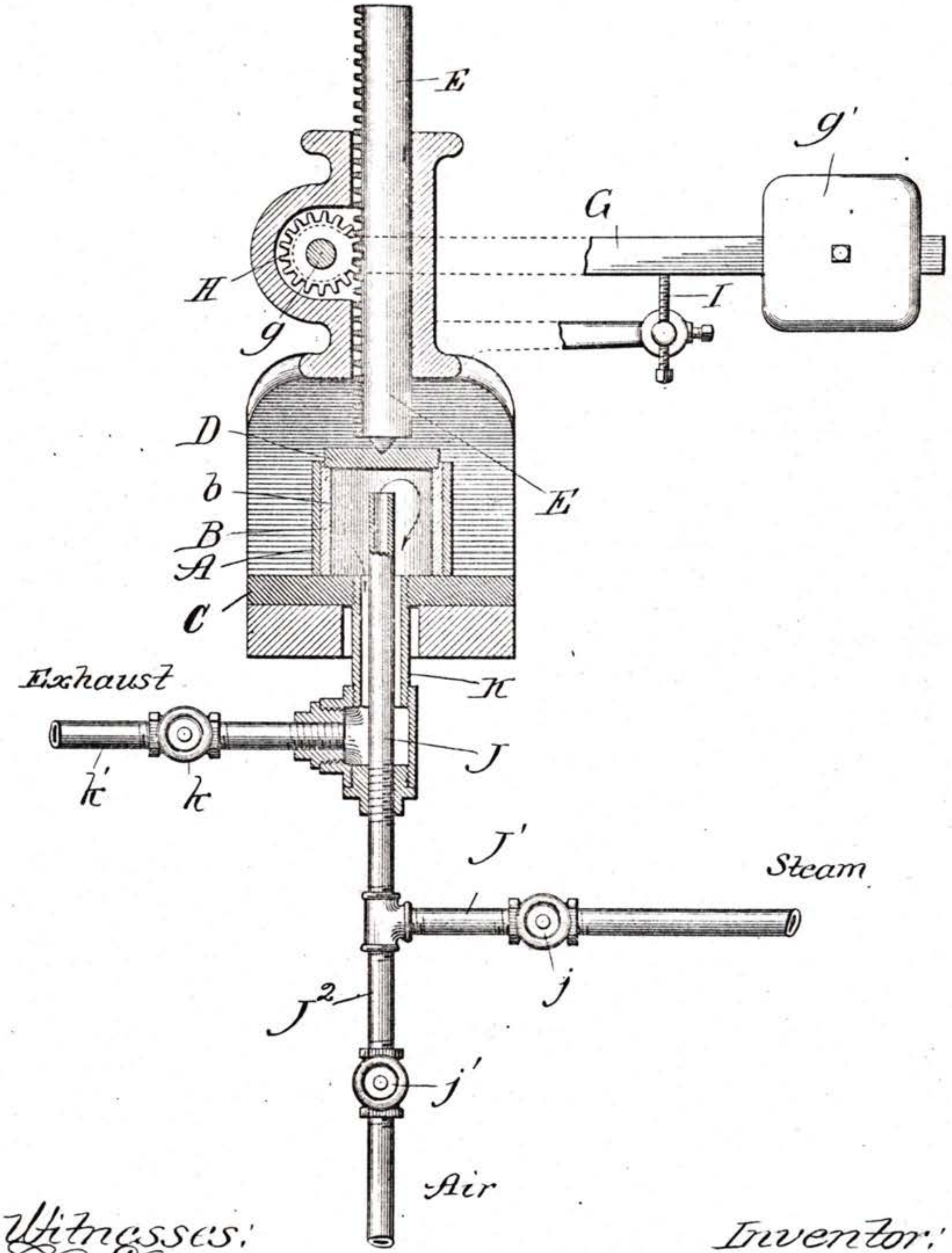
No. 742,454. PATENTED OCT. 27, 1903.

T. B. LAMBERT.

PROCESS OF REPRODUCING PHONOGRAPHIC RECORDS.

APPLICATION FILED JUNE 14, 1900.

NO MODEL.



Witnesses:
Chas. E. Gaylord,
John Enders Jr.

Inventor:
Thomas B. Lambert.
By Thomas F. Sheridan
Att'ys.

No. 742,454 Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

THOMAS B. LAMBERT, OF CHICAGO, ILLINOIS, ASSIGNOR TO LAMBERT COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PROCESS OF REPRODUCING PHONOGRAPHIC RECORDS.

SPECIFICATION forming part of Letters Patent No. 742,454, dated October 27, 1903.

Application filed June 14, 1900. Serial No. 20,249. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS B. LAMBERT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Processes of Producing Duplicate Phonographic Records, of which the following is a specification.

This invention relates particularly to processes by which the ordinary record now used in connection with phonographs may be copied or duplicated any number of times, and especially to the production of indestructible duplicate-records, all of which will more fully hereinafter appear.

The principal object of the invention is to provide a simple, economical, and efficient process of reproducing phonographic records; and the invention consists in the process hereinafter described and claimed.

The accompanying drawing represents a vertical sectional elevation of one style of apparatus in which my improved process may be carried out.

In carrying out my process I provide a matrix A of the desired size, shape, and strength and which is preferably cylindrical in contour and formed of copper which has been electrochemically deposited upon a wax cylinder in the manner shown and described in Patent No. 645,920, issued to me on the 20th day of March, 1900, and which it is therefore unnecessary to show and describe in detail here. The inner side of this copper matrix is provided, as is shown in the above-named patent, with a negative of a record-cylinder provided with a surface having indentations which correspond with the projecting portions of the record and projections which correspond with the indentations on the record-cylinder, and in order to make duplicate records I place within such matrix a blank record-cylinder B, formed of celluloid or similar substance—in fact, it can be formed of any substance which is susceptible of being softened by heat and rehardened by cooling. This blank record-cylinder, which may be made of celluloid or other desirable material, is, as above stated, placed within the matrix, so that the record and matrix both rest upon a base C, which acts as a closure for one end of the chamber inside the record and which I will hereinafter term the "record-chamber" *b*. A head portion D is next placed upon the record-cylinder to complete the closing of the record-chamber. An air-tight chamber, which I will designate as the "record-chamber," is thus formed within the blank record-cylinder and between the movable head D and the base C. This movable head should be of such diameter as to leave an opening between it and the matrix when the head is in contact with the record-cylinder at a point within or near the matrix, and the opening should be narrower than the thickness of the record-cylinder. The opening will then be closed and sealed by the record-cylinder when pressure sufficient to expand it is applied within, and, as will be readily seen, this opening affords an outlet for the air to escape between the head and matrix and from between the record-cylinder and matrix. This arrangement of the head and matrix leaves the matrix to rest loosely upon the base without anything to hold it unyieldingly against the base. The natural irregularities of the adjacent surfaces of the matrix and base thus afford a sufficient opening between the lower end of the matrix and base to permit air to escape from between the record-cylinder and matrix. In fact, in the absence of anything to hold the matrix rigidly and unyieldingly against the base—such, for instance, as a head in unyielding contact with the opposite end of the matrix—the application of the pressure within the record will force the air from between the record-cylinder and base however regular their adjacent surfaces may be. The natural irregularities of the adjacent surfaces, however, insure a sufficient vent when the relation of the head and matrix is as described, and a gear-spindle E is allowed to drop down thereon. A weighted lever G is provided and mounted upon the shaft *g*, which carries a pinion H, meshing with the rack *e*, which in turn operates the spindle above named, and in connection with a stop-screw I determines the position and the amount of pressure with which this spindle may rest on the head.

It is now desirable to soften the record-cylinder so that it may be expanded out against the indented record-surface of the matrix and expand the record-cylinder. In order to accomplish this, steam under about thirty pounds pressure to the square inch is forced into the record-chamber through a supply-pipe J, which is connected, by means of a branch pipe J', with a suitable source of steam-supply. The steam is permitted to escape again out through an exhaust-pipe K, connected with the outer air by means of the branch K'. The steam is kept at a substantially uniform pressure within the record-cylinder chamber, so as to by means of its heat and other actions soften the record and force it out against the inner indented surface of the matrix. After this has been accomplished—and experience teaches the operator just how long under certain pressure it takes the steam to accomplish this result—the steam-supply is shut off by means of the valve *j* and a supply of cool air under pressure is permitted to enter through the supply-pipe J by opening the valve j' on a second branch pipe J^2, which connects with a source of air under pressure and keeps up practically the same pressure as heretofore, but leaves the valve *k* on the exhaust-pipe open, so that all moisture and steam is blown out of the record-chamber, as above described. When the steam has been blown out, the next step is to shut the valve *k* and permit air under the desired pressure to stay in the record-chamber until such blank record is substantially forced into all the indentations made by the record on the inner surface of the copper matrix. As soon as this has been accomplished the air-supply is shut off, leaving just enough air inside the record-chamber to cool the same, and the exhaust-valve *k* is opened sufficiently to permit the air to blow through under certain pressure, and thus assist materially in cooling the record-cylinder.

When the duplication of the record-cylinder has been completed, the spindle E is raised, the head D removed, and the matrix, with its duplicated record, removed from contact with the apparatus. The cooling of the record-cylinder also shrinks it, so that it can be easily removed from engagement with the matrix.

Whenever desirable or necessary, the outer periphery of the matrix may be backed by plaster-of-paris, having a lead or other metallic confining-ring to give it sufficient rigidity to secure the duplication or reproduction of the records, and this is very clearly shown and described in the patent above referred to.

I claim—

1. The process of producing records of the class described, which consists in placing a blank record-cylinder adjacent to the record-surface of an indented matrix, then forcing a supply of heated fluid under pressure against the exposed surface of the record-blank until such record has been softened and forced into the indentations of the matrix, and then furnishing a supply of cool fluid under pressure to complete the production of the record, and finally removing the record-cylinder, substantially as described.

2. The process of producing duplicate phonographic records, which consists in placing a blank record-cylinder adjacent to the inner indented surface of a cylindrical matrix, then passing into the chamber formed inside the record-cylinder a supply of steam under pressure, furnishing a supply of cool fluid under pressure to blow the steam out of the said record-chamber, complete the production of the phonographic record, and finally removing the record-cylinder, substantially as described.

3. The process of producing phonographic records, which consists in placing a blank record-cylinder within and adjacent to the indented record-surface of a cylindrical matrix and closing the ends of the record-cylinder so as to provide an interior chamber, next furnishing a supply of steam under pressure to such chamber and permitting it to blow through so as to prevent or minimize the condensation of the steam, furnishing a supply of air under pressure to complete the production of the record, and finally removing the record-cylinder, substantially as described.

4. The process of producing records of the class described, which consists in placing a blank record-cylinder adjacent to the mold-surface of a matrix in position to provide an outlet-opening communicating with the space between the record-cylinder and the matrix, then closing the ends of the record-cylinder without closing the opening communicating with the space between the record-cylinder and matrix, then applying fluid under pressure within and heat to the record-cylinder, and then applying a cool fluid to the record-cylinder, and then removing the record-cylinder, substantially as described.

5. The process of producing records of the class described, which consists in placing a blank record-cylinder adjacent to the mold-surface of a matrix in position to provide an outlet-opening communicating with the space between the record-cylinder and the matrix, then closing the ends of the record-cylinder without closing the opening communicating with the space between the record-cylinder and matrix, then applying steam under pressure within the record-cylinder, and then applying a cool fluid to the record-cylinder, and then removing the record-cylinder, substantially as described.

6. The process of producing records of the class described, which consists in placing a blank record-cylinder adjacent to the mold-surface of a matrix in position to provide an outlet-opening communicating with the space between the record-cylinder and matrix, then closing the ends of the record-cylinder with-

out closing the opening communicating with the space between the record-cylinder and matrix, then applying fluid under pressure to the record-cylinder and then removing the record-cylinder, substantially as described.

7. The process of producing phonographic records, which consists in placing a record-blank adjacent to the mold-surface of the matrix in position to provide an outlet-opening communicating with the space between the record-blank and the matrix, then arranging a movable head adjacent to the record-blank so as to form in combination with such blank a chamber without closing the opening communicating with the space between the record-blank and matrix, then applying fluid under pressure within the chamber to complete the production of the record, and then removing the record, substantially as described.

8. The process of duplicating records of the class described that consists in placing a blank record-cylinder adjacent to the record-surface of a matrix, supplying heated fluid against the exposed surface of the blank record-cylinder until such cylinder has been softened, then furnishing a supply of cool fluid under pressure to said cylinder to complete the duplication of the record and finally removing the record-cylinder, substantially as described.

THOMAS B. LAMBERT.

Witnesses:
THOMAS F. SHERIDAN,
BRIAN F. PHILPOT.

No. 683,615. Patented Oct. 1, 1901.

W. H. MILLER & J. W. AYLSWORTH.

METHOD OF DUPLICATING PHONOGRAPHIC RECORDS.

(Application filed July 31, 1900.)

(No Model.)

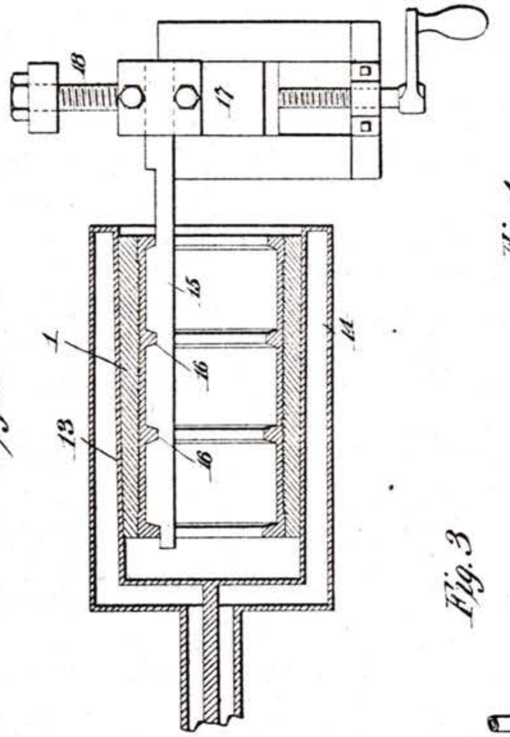


Fig. 2

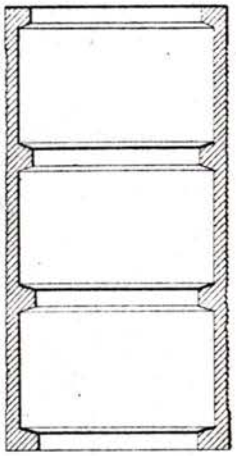


Fig. 4

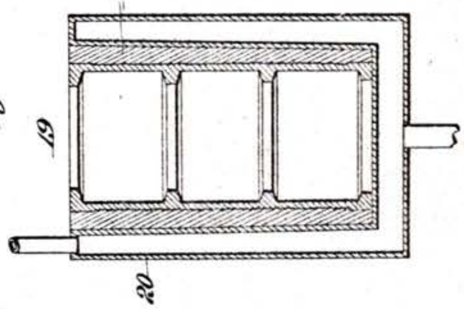


Fig. 3

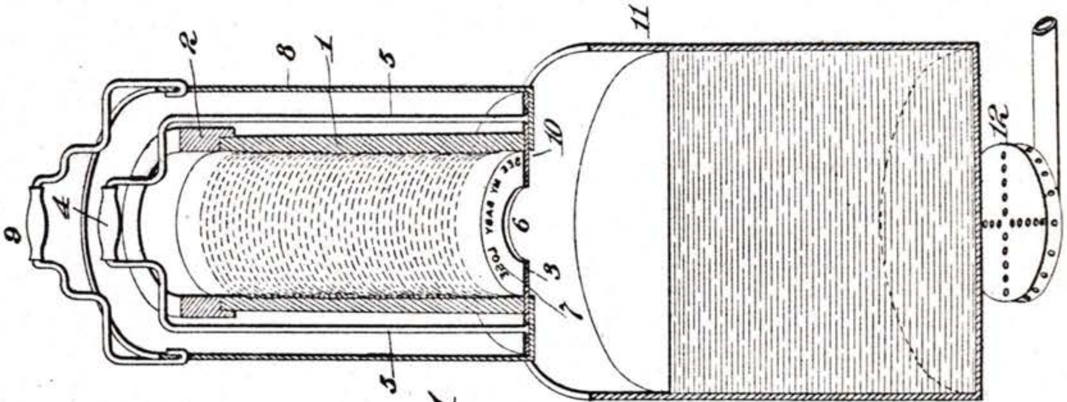


Fig. 1

Witnesses:

Jas. F. Coleman

Jno. R. Taylor

Inventors

Walter Henry Miller

Jonas Walter Aylsworth

by Dyer Edmonds & Dyer Att'ys.

UNITED STATES PATENT OFFICE.

WALTER HENRY MILLER, OF ORANGE, AND JONAS WALTER AYLSWORTH, OF EAST ORANGE, NEW JERSEY, ASSIGNORS TO NATIONAL PHONOGRAPH COMPANY, OF ORANGE, NEW JERSEY.

METHOD OF DUPLICATING PHONOGRAPHIC RECORDS.

SPECIFICATION forming part of Letters Patent No. 683,615, dated October 1, 1901.

Application filed July 31, 1900. Serial No. 25,391. (No specimens.)

To all whom it may concern:

Be it known that we, WALTER HENRY MILLER, of Orange, and JONAS WALTER AYLSWORTH, of East Orange, in the county of Essex and State of New Jersey, citizens of the United States, have invented a certain new and useful Method of Duplicating Phonographic Records, of which the following is a description.

Our invention relates to an improved process of duplicating phonographic records; and our object is to provide a process by which the duplicating of phonographic records can be carried on expeditiously and economically and duplicate records produced which are of superior quality.

In carrying our invention into effect we first secure a matrix or mold from which copies are to be produced, said matrix or mold being made by any suitable and approved process—as, for instance, by a process of electroplating on a vacuous deposit preliminarily secured upon an original phonographic cylinder, the electroplating being suitably backed up and strengthened by a metal jacket and the original cylinder being removed from the electroplated coating in any suitable way, as by melting the record or by contracting it by cold. The resulting matrix will obviously be a cylinder carrying on its bore a representation in negative or relief of the original record. From the matrix or mold secured in this or in any other approved way we make duplicates by a process of immersion or dipping of the matrix or mold in a bath of molten wax-like material from which the duplicates are to be secured, whereby a coating or covering of such material will be deposited upon the interior of the matrix or mold by reason of the lower temperature of the matrix or mold. After thus securing a sufficiently thick coating of material on the interior of the matrix or mold we remove the latter from the bath, carrying the deposited material with it, and we properly finish the duplicate so secured by reaming its interior to gage, trimming one of its ends, and afterward shrinking the duplicate from the matrix or mold.

In carrying out our improved process we may utilize any suitable apparatus for the purpose, and the apparatus illustrated in the accompanying drawings, which form a part of this specification, is merely an illustrative one and we do not wish to be limited thereto.

In the drawings, Figure 1 is a sectional view of the apparatus and mold in which the deposit or coating of the wax-like material is secured; Fig. 2, a corresponding view of the apparatus for properly reaming the interior of the duplicates; Fig. 3, a similar view of the apparatus employed for the shrinking of the duplicates from the matrix or mold, and Fig. 4 an enlarged corresponding view of one of the resulting duplicates.

In all of the above views corresponding parts are represented by the same numerals of reference.

1 represents a matrix or mold carrying on its bore the representation of the record which is to be duplicated, said representation being obviously in negative or relief. This matrix or mold is made by any approved process and is not a part of our invention.

2 is a metal cap which is removably fitted upon the upper end of the matrix or mold, with its bore corresponding in diameter with the bore of the matrix or mold.

3 is a metal disk provided with a handle 4, connected to side bars 5 5 and by which the disk may be manipulated. The matrix or mold 1 is carried by the disk 3, as shown. An opening 6 in the disk 3 is of considerably less diameter than the bore of the matrix or mold, and around said opening 6 and within the bore of the matrix or mold the disk may be formed in negative with a representation 7 of suitable words or characters to indicate the subject-matter of the duplicated record, its source of origin, &c.

8 is a sheet-metal receptacle provided with a handle 9 and which carries the disk 3 and the matrix or mold 1, as shown. The receptacle 8 is provided with an opening 10 therein, which may be of the same or of larger size than the opening 6 in the disk 3.

11 represents a tank which contains, as indicated, a proper supply of suitable wax-like material from which the duplicates are to be made and which material may be the

ordinary commercial phonographic compositions now in use. The material in the tank 11 may be kept in a molten condition by heat applied in any suitable way, as by means of a gas-burner 12.

In carrrying out our process with the apparatus so far described we place the matrix or mold on the disk 3 and insert the latter, carrying the matrix or mold in the receptacle 8, as shown, after which the receptacle 8 is immersed in the molten material within the tank 11, which is permitted to enter the matrix or mold to a point above the upper end of the latter, but below the top of the cap 2, so that the material fills the interior of the matrix or mold, but does not overflow the same. The matrix or mold is thus kept immersed in the molten material for the desired time required to secure a deposit of the wax-like material of the required thickness. With the ordinary commercial phonographic composition now used maintained at from 20° to 40° above its melting-point and with a matrix or mold having a thickness of about one-fourth of an inch a deposit of material will be formed on the interior of the matrix or mold of the desired thickness after an immersion of about three minutes. Obviously, however, this time will vary with the peculiar conditions under which the process may be carried out; but in no instance should the matrix or mold be immersed within the molten material for a long enough time to allow its temperature to be raised sufficiently to permit the deposited molten material thereon to become remelted. The reduced temperature of the matrix or mold relative to the temperature of the molten material causes the latter to become coagulated or chilled on the interior of the matrix and to deposit thereon to the thickness desired. This chilling also makes the outer surface of the resulting duplicates much smoother than is the case with duplicates made by a mechanical duplicating process. Owing to the thinness of the walls of the receptacle 8 the metal thereof very quickly attains the temperature of the molten material, so that none of the molten material will accumulate thereon. It will be understood that the matrix or mold may be made of increased thickness or be artificially cooled before the dipping operation when the composition is of a character requiring an increased cooling effect to secure the desired thickness of deposit. When the desired deposit of molten material is secured, the receptacle 8 is removed from the bath of molten material and the disk 3, carrying the mold, is removed from said receptacle. Obviously the lower edge of the resulting duplicate will be perfectly true, being formed by the portion of the disk 3 between the opening 6 and the bore of the matrix or mold, and if a representation 7 is formed on that portion of the disk such representation will be cast in the bottom end of the duplicate. The cap 2 is now removed from the matrix or mold and the upper end of the duplicate is trimmed off flush with the upper surface of the matrix or mold by any desired form of cutting-tool. The matrix or mold, which has a slightly-tapered outer surface, is now placed in a tapered chuck 13, as shown in Fig. 2, which chuck is provided with a water-jacket 14, through which cold water may circulate in order that the matrix or mold may be kept cold enough to maintain the resulting duplicate or at least the outer surface thereof in a chilled and hardened condition. The chuck 13 being rotated in any suitable way, a reaming-tool 15, held at an angle to give the desired taper to the bore of the duplicate, is introduced within the same, and by reason of the cut-away portions 16 in said reaming-tool a series of ribs will be formed on the duplicate, as shown in Fig. 4, by which the latter will be properly held upon the mandrel of the reproducing-phonograph in the usual way. The reaming-tool 15 is carried by the usual slide-head 17 of the lathe, and the depth of cut of said tool is limited by a regulating-screw 18, as shown. This reaming of the interior of the duplicate is preferably carried on before the resulting duplicate has cooled sufficiently to become hard and before it has contracted from the bore of the matrix, whereby the reaming operation can be carried on effectively and smoothly. After the interior of the duplicate has been properly reamed, as explained, the matrix or mold is removed from the chuck 13 and inserted in a cooling-mold 19, having a water-jacket 20 and through which cold water may circulate, the matrix or mold being kept in the cooling-mold until the resulting duplicate has contracted sufficiently to enable it to be removed from the matrix or mold, whereupon the operation will be completed. By reaming the interior of the resulting duplicates, as explained, to form a series of ribs therein the duplicates may be made much thinner than the ordinary original records, and hence more economically, it being of course understood that the material removed by the reaming-tool will be used for the manufacture of subsequent duplicates.

While our improved process is particularly adapted for the manufacture of duplicate records, it will be understood that the process may be carried out in connection with the manufacture of phonograph-blanks by employing a matrix or mold having a smooth bore, in which a deposit may accumulate by a process of immersion, as described. The deposited blank will be reamed on its interior, trimmed on its outer edge, and removed by shrinking or otherwise in exactly the same way as that described in connection with the manufacture of duplicate records. Such a process not only provides for the cheap and effective manufacture of phonograph-blanks, but by its carrying out a superior article is produced, since the record-surface of the blanks will be smooth and calendered in appearance. With such blanks therefore after having received a record in any suitable way the reproduction will be smoother and freer of extraneous sounds than reproductions obtained from records made on other blanks.

We do not claim herein the apparatus above described for carrying our invention into effect, since such apparatus is made the subject of our companion application filed on even date herewith and numbered serially 25,392.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is as follows:

1. The method of making a cylindrical phonographic surface, which consists in immersing a continuous tubular mold in a molten wax-like coagulable material, whereby the material will accumulate on the bore of the mold and will chill thereon in a layer of the desired thickness, then in contracting the deposited material, and finally in removing it longitudinally from the mold, substantially as set forth.

2. The method of duplicating phonographic records, which consists in immersing a continuous cylindrical mold or matrix carrying the record in relief on its bore in a molten wax-like coagulable material, whereby the material will accumulate on the bore of the matrix or mold and chill thereon in a layer of the desired thickness, then in contracting the deposited material, and finally in removing it by a direct longitudinal movement from the matrix or mold, substantially as set forth.

3. The method of duplicating phonographic records, which consists in immersing a mold or matrix carrying the record in relief on its bore in a molten wax-like coagulable material, whereby the material will accumulate on the bore of the matrix or mold and chill thereon in a layer of the desired thickness, in finishing the bore of the duplicate so secured, and in separating the duplicate from the matrix or mold, substantially as set forth.

4. The method of duplicating phonographic records, which consists in immersing a mold or matrix carrying the record in relief on its bore in a molten wax-like, coagulable material, whereby the material will accumulate on the bore of the matrix or mold and chill thereon in a layer of the desired thickness, in finishing the bore of the duplicate so secured, and in shrinking the duplicate from the matrix or mold, substantially as set forth.

5. The method of duplicating phonographic records, which consists in immersing a mold or matrix carrying the record in relief on its bore in a molten wax-like coagulable material, whereby the material will accumulate on the bore of the matrix or mold and chill thereon in a layer of the desired thickness, in finishing the bore of the duplicate so secured before the latter has become hard, and in separating the duplicate from the matrix or mold, substantially as set forth.

6. The method of duplicating phonographic records, which consists in immersing a matrix or mold carrying the record in relief on its bore in a molten wax-like coagulable material which is excluded from the exterior of the matrix or mold and only enters the bore thereof, whereby the reduced temperature of the matrix or mold causes the material to chill on the bore and accumulate in a layer of the desired thickness, in removing the matrix or mold from the molten material, in trimming the bore of the duplicate so secured, and in separating the duplicate from the matrix or mold, substantially as set forth.

7. The method of duplicating phonographic records, which consists in immersing a matrix or mold carrying the record in relief on its bore in a molten wax-like coagulable material which is excluded from the exterior of the matrix or mold and only enters the bore thereof, whereby the reduced temperature of the matrix or mold causes the material to chill on the bore and accumulate in a layer of the desired thickness, in removing the matrix or mold from the molten material, then in maintaining the reduced temperature of the matrix or mold while the interior of the duplicate is finished, and finally in further reducing the temperature of the matrix or mold to cause the resulting duplicate to be contracted, whereby it may be removed by a direct longitudinal movement, substantially as set forth.

This specification signed and witnessed this 17th day of July, 1900.

WALTER HENRY MILLER.
JONAS WALTER AYLSWORTH.

Witnesses:
J. L. EVANS,
HENRY WACHENFELD.

No. 667,662. **Patented Feb. 5, 1901.**

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAPH RECORDS.

(Application filed May 8, 1900.)

(No Model.)

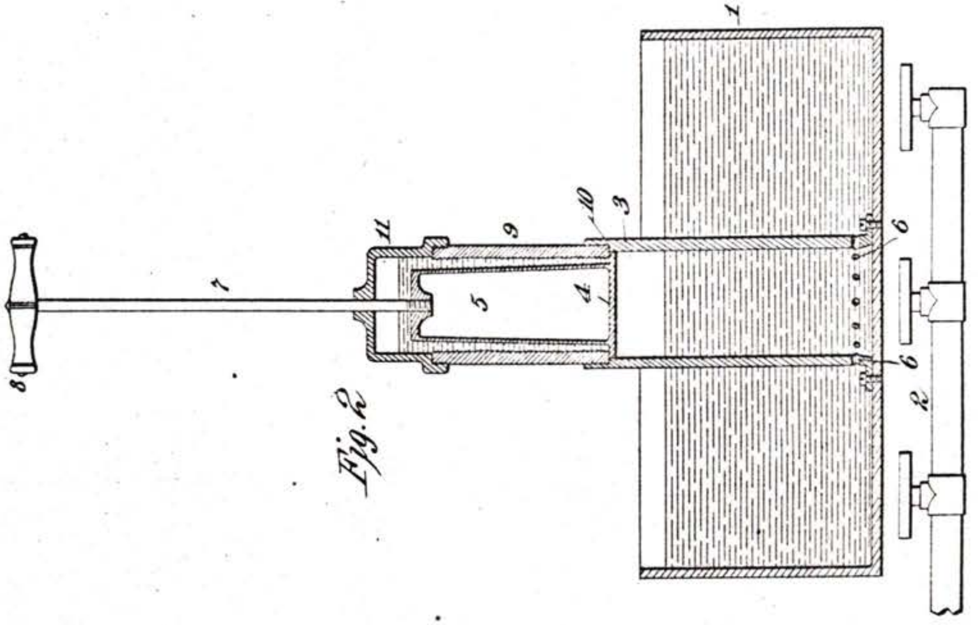


Fig. 2

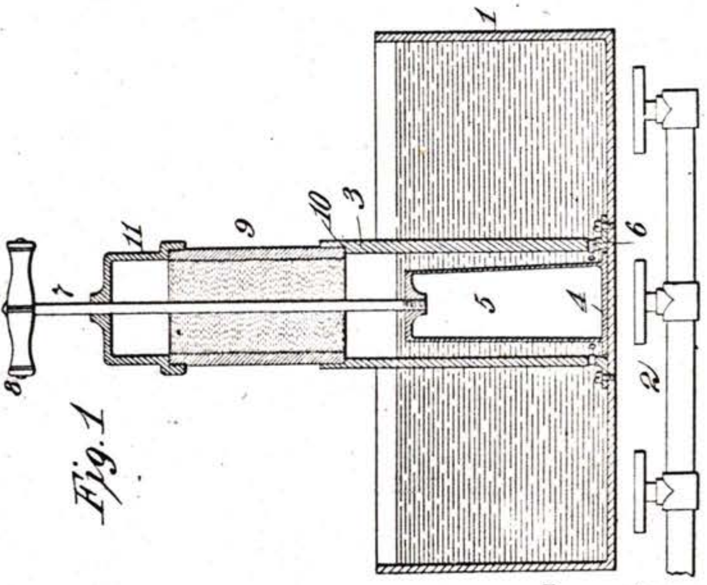


Fig. 1

Witnesses:
Jas. F. Coleman
Jno. R. Taylor

Inventor
Thomas A. Edison
by Dyer Edmonds & Dyer
Att'ys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY

PROCESS OF DUPLICATING PHONOGRAPH-RECORDS.

SPECIFICATION forming part of Letters Patent No. 667,662, dated February 5, 1901.

Application filed May 8, 1900. Serial No. 15,874. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, county of Essex, and State of New Jersey, have invented a certain new and useful Improved Process of Duplicating Phonograph-Records, (No. 1,036,) of which the following is a specification.

My invention relates to an improved process for duplicating phonograph-records, and the process is of the character covered by my Patent No. 484,582, of October 18, 1892, wherein a matrix of an original record is employed as a mold for the making of the duplicates. In the specific process described in my previous patent the matrix secured from the original record is divided longitudinally, so as to form a sectional mold in which are cast the desired duplicates. My present invention is designed specifically as an improvement on said process, and my object is to provide a process wherein the production of the duplicate records will be facilitated and wherein the character of the resulting duplicates will be improved, since the mold used is continuous on its bore.

My present process depends upon the fact that after a molten metallic soap or a mixture of soaps or other suitable material has been introduced within a mold carrying the representation of a phonographic record in relief on its bore and allowed to set a sufficient contraction of the resulting duplicate can be secured as to permit of a longitudinal separation of the duplicate from the mold, whereby a continuous mold can be employed for the carrying on of the process.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a sectional view of a suitable apparatus for the purpose, illustrating the plunger and piston in their lowermost position; and Fig. 2, a similar view showing the same parts in their elevated positions.

In both the above views corresponding parts are represented by the same numerals of reference.

The apparatus illustrated in the figures is designed for the duplicating of cylindrical phonographic records, and it will be so described; but the applicability of my process for the duplication of other varieties of records will be apparent to those skilled in the art.

In the drawings, 1 represents a suitable jar or tank of the proper dimensions and made of any desired material. Within the jar or tank 1 I place the material of which the duplicate records are to be formed and which may be maintained in a molten condition by the application of heat in any way—as, for example, by a gas-tube 2, supplying a number of jets, as shown. The proper level of the molten material is indicated, and this level should be approximately maintained by the addition of fresh material from time to time within the tank as the liquid material may be withdrawn during the operation. The material in the tank 1 and of which the duplicate records are to be formed may be of any suitable character; but preferably it is a metallic soap or a combination of several soaps to which has been added a material not affected by water, such as ceresin, whereby the resulting duplicates will be protected from the effects of atmospheric moisture. Mounted within the tank and secured to its bottom is an open-ended cylinder 3, in which works a piston 4. A tapered core 5 is connected to or formed integrally with the piston 4, and said core is preferably hollow, so as to present a thin wall to the material, whereby the core will very quickly reach the temperature of the molten material when it is immersed therein. A number of openings 6 are formed in the cylinder 3, near the bottom thereof, below which openings the piston 4 passes in reaching its downward position, as shown in Fig. 1, whereby the liquid material may flow through said openings into the cylinder above the piston. Connected to the core 5 is a plunger 7, having an operating-handle 8. The connection between the core and plunger is such as will permit a separation of these parts, ordinary screw-threads being shown.

9 represents a mold which rests within a shoulder 10, formed at the top of the cylinder, and which mold carries on its bore the representation in negative or relief of a phonograph-record which it is desired to duplicate. This mold is preferably obtained by

the process described in my application for Letters Patent filed March 5, 1898, Serial No. 672,650, by first depositing upon the original record a suitable metal in the form of an infinitesimally-thin film by a process of vacuous deposit, by then electroplating or otherwise securing upon the film so obtained a sufficiently thick layer of the same or different metal, and by then properly backing up the metal so deposited or otherwise applied to the vacuous film either before or after the separation of the original record from the inclosing coating of metal either by contracting the record or by melting it out or in any other suitable way. The advantage of making a matrix or mold by first depositing upon an original phonograph-record a metal by a process of vacuous deposit is that an absolutely accurate copy in negative of such record will be produced irrespective of the fineness thereof. The mold 9 is preferably made of sufficient mass or thickness as to effectively chill the molten material when the latter is introduced therein, as I shall explain. Carried by the upper part of the mold is an inclosing cap 11, which may be secured onto the mold and which forms a bearing for the plunger 7.

In carrying out my improved process with an apparatus of this type I prefer to proceed substantially as follows: Molten material being placed within the tank or jar 1 is maintained in its liquid or fluid condition by the application of heat. The mold 9, being exposed to the atmospheric temperature, is relatively cold. The plunger 7 is first depressed, so as to force the piston 4 downward within the cylinder, ejecting the liquid material from beneath it, which material passes out through the openings 6. The bore of the cylinder 3 may, as shown, be slightly enlarged below the openings 6, so as to permit the piston 4 to pass beneath the same. As soon as the piston 4 passes below the openings 6 the molten or fluid material enters the cylinder above the piston, so as to fill the cylinder to the level of the liquid in the tank or jar. Owing to the thin wall of the core 5 the latter will almost immediately reach the temperature of the molten material, so that said core will not chill the latter. If a solid core is used, it will require to be immersed within or below the surface of the liquid material for a longer time to enable its temperature to reach that of the molten mass; but with this exception the process will be equally operative with a solid core as with a hollow core.

Assuming the hollow core to be used and that its temperature reaches that of the molten material almost immediately, the plunger 7 will be elevated, so as to carry the charge of molten material above the piston into the mold, as shown in Fig. 2, a greater or less excess of material passing above the mold into the cap 11. By employing the cap 11 it will be obvious that the level of the liquid material in the tank or jar may be varied considerably without affecting the operation. The liquid molten material entering the mold 9 will engage all portions of the record formed on the bore thereof, and the materially lower temperature of the mold will result in the almost instantaneous chilling of the surface of the molten material therein. In order to facilitate this surface-chilling of the liquid molten material entering the mold, the latter may be actually cooled by artificial means below atmospheric temperature—as, for instance, by the circulation of cold water through a water-jacket surrounding the mold or by a blast of cold air equably directed to all portions of the mold. The chilling of the surface of the molten material in the mold results in the setting of the positive impression thus secured from the negative record. The chilling of the molten material in the mold progresses toward the center, and any contraction in bulk will be compensated by the surplus material within the cap 11. As soon as the material within the mold has been chilled throughout the entire thickness thereof the material with the piston, core, cap, and plunger are removed from the cylinder, and the material is allowed to cool by exposure to a cold atmosphere or by an air-blast until the solidified material has contracted away from the bore of the mold, so as to permit it to be removed therefrom by forcing the plunger downward. The plunger is then removed from the core, and the latter is extracted from the cast duplicate, carrying the positive record on its periphery before the material has contracted sufficiently upon the core as to prevent this separation. Since the conductivity of heat from the material is effected slowly, the outer surface of the molded duplicate becomes hard and set, while the inner portion thereof next to the core is still in a relatively plastic condition, so that this separation of the core can with ordinary care be readily effected. The resulting duplicates thus secured after reaching the normal temperature are properly dressed at the ends and are reamed internally to the proper size, being then ready for use.

With records made by my process the contraction of the material radially to separate it from the mold is accompanied by a considerable longitudinal contraction following the instant when the surface is first set by the chilling effect of the mold and progressing until the material reaches the normal temperature, such shrinkage being approximately one per cent. with ordinary blanks. For this reason it is desirable that the original record from which the matrix is made is formed on a phonograph or allied talking-machine having a fewer number of threads on its feed-screw than the instrument on which the duplicates are finally used, in order that when the contraction has progressed to its finality the pitch of the record-thread on the duplicate will correspond to the pitch of the feed-screw of the reproducing-machine or approximately to that pitch, it being possible with modern reproducing apparatus to effect a satisfactory reproduction from a record, even when the pitch thereof differs slightly from that of the feed-screw of the machine. The pitch of the feed-screw of the machine on which the original record is made will differ from the pitch of the feed-screw of the machine on which the resulting duplicates are to be used to an extent depending upon the coefficient of contraction of the material used and will be determined by experiment with the material employed. It will be of course understood that after the mold has been removed from the cylinder and the separation of the cast duplicate is being effected therefrom a new mold and its accompanying parts may be inserted in place upon the cylinder, and the operations repeatedly carried on therewith.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. The process of duplicating cylindrical phonographic records, which consists in first making an original record with a spiral record-groove of greater pitch than that desired on the duplicate to be produced, then in making a hollow cylindrical matrix or mold from said original record, carrying the record in negative on its bore, and in finally making duplicate records from the matrix or mold by introducing therein and engaging therewith material maintained in an abnormally high temperature, whereby the cooling of such duplicate will contract the pitch of the record-groove, as and for the purposes set forth.

2. The process of duplicating phonographic records, which consists in securing a mold containing the record in negative on its bore, in introducing a molten material in the mold to receive a surface impression from such record, in allowing the molten material to set, in contracting the set material, and in separating the contracted molded material by a longitudinal movement, substantially as set forth.

3. The process of duplicating phonographic records, which consists in securing a mold having a record in relief in negative on its bore, in introducing a molten material in the mold around a core, in allowing the molten material to set, in contracting the set material, in removing the contracted material and the core from the mold, and in separating the core from the molded material, substantially as set forth.

4. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold with a record in negative on its bore, in introducing a molten material in the mold to form a cylindrical duplicate, in allowing the duplicate to set, in contracting the duplicate, and in removing the contracted duplicate by a direct longitudinal movement, substantially as set forth.

5. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold having the record in negative on its bore, in introducing molten material in the mold around a core, whereby a hollow cylindrical duplicate will be formed, in allowing the molten material to set, in contracting the molten material, and in withdrawing the contracted material from the mold by a direct longitudinal movement, substantially as set forth.

6. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold carrying the record in negative on its bore, in introducing a molten material in the mold around a core, in allowing the material to set, in contracting the material, in withdrawing the contracted material and core from the mold, and in separating the core from the resulting duplicate, substantially as set forth.

7. The process of duplicating cylindrical phonograph-records, which consists in making a cylindrical mold carrying a record in negative on its bore, and of sufficient mass to produce a chilling effect on molten material introduced therein, then in introducing within the mold a molten material, the surface of which becomes chilled by contact with the mold, then in contracting the duplicate so formed, and finally, separating the duplicate from the mold by a direct longitudinal movement, substantially as set forth.

8. The process of duplicating cylindrical phonograph-records, which consists in securing a mold carrying a record in negative on its bore, and of sufficient mass to produce a chilling effect on molten material introduced therein, then in introducing within the mold around a core a molten material, the surface of which is chilled by contact with the mold, then in contracting the material, then in removing the contracted material and core from the mold, and in finally separating the core from the material, substantially as set forth.

9. The process of duplicating cylindrical phonograph-records, which consists in maintaining in a molten condition a mass of material from which the duplicates are to be made, in sustaining a mold over the mass of molten material, said mold carrying on its bore a record in negative, in successively elevating a part of the mass of molten material into the mold, in allowing such molten material within the mold to set, in contracting the set material, and in withdrawing the resulting duplicate from the mold by a direct longitudinal movement, substantially as set forth.

This specification signed and witnessed this 30th day of April, 1900.

THOS. A. EDISON.

Witnesses:
J. F. RANDOLPH,
FRANK L. DYER.

No. 666,493. Patented Jan. 22, 1901.

F. L. CAPPS.

DUPLICATE SOUND RECORD AND PROCESS OF FORMING SAME.

(Application filed Mar. 8, 1899.)

(No Model.)

Fig.1.

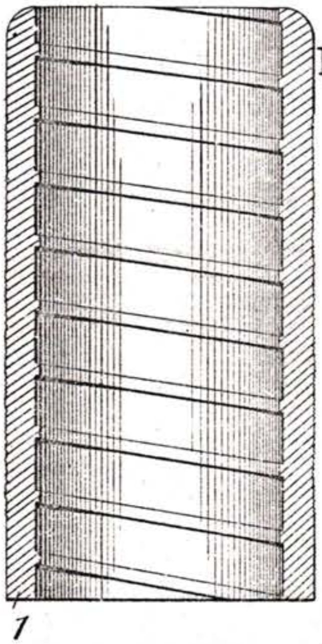


Fig.2.

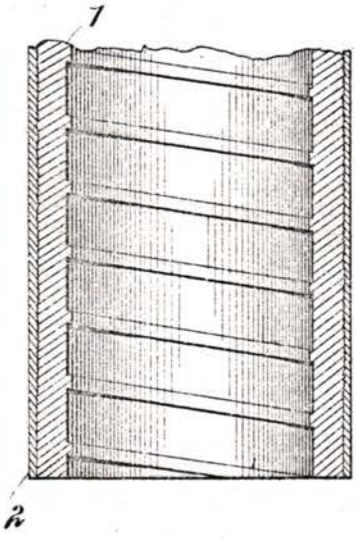


Fig.3.

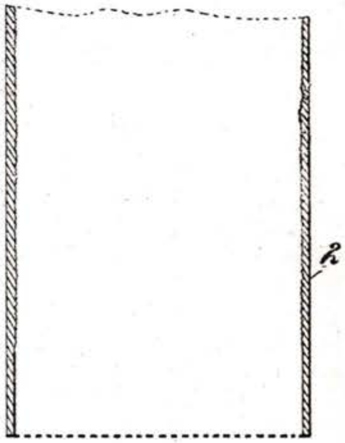


Fig.4.

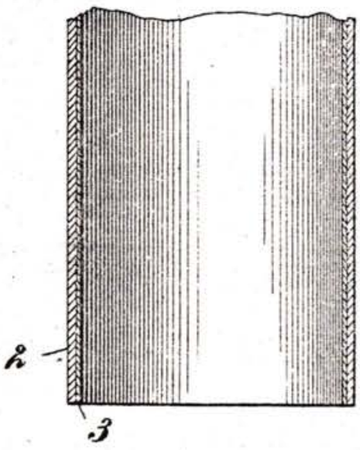


Fig:5.

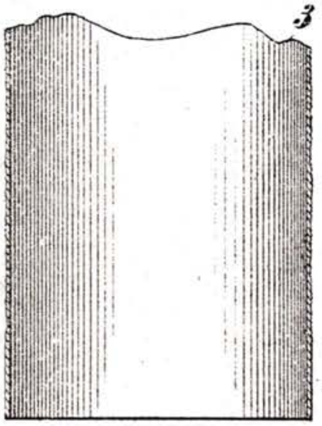
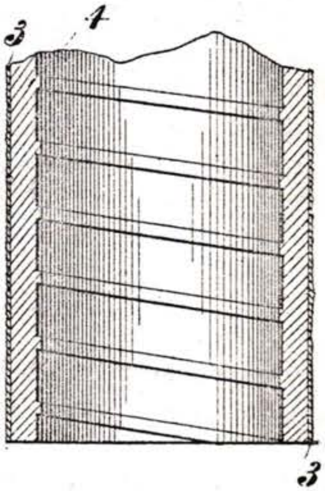


Fig.6.



WITNESSES

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INVENTOR

Frank L. Capps

BY

Knight Bros

ATTORNEYS

UNITED STATES PATENT OFFICE.

FRANK L. CAPPS, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE AMERICAN GRAPHOPHONE COMPANY, OF WASHINGTON, DISTRICT OF COLUMBIA.

DUPLICATE SOUND-RECORD AND PROCESS OF FORMING SAME.

SPECIFICATION forming part of Letters Patent No. 666,493, dated January 22, 1901.

Application filed March 8, 1899. Serial No. 708,183. (No model.)

To all whom it may concern:

Be it known that I, FRANK L. CAPPS, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes of Forming Duplicate Sound-Records, of which the following is a specification.

The object of my invention is to economically produce and duplicate sound-records.

There are two methods of duplicating sound-records now commonly employed. The first of these methods is the mechanical method, carried out by a suitable duplicating-machine provided with reproducing and recording styli, which respectively follow the record-groove of a rotating master-record and cut a duplication of the record in a correspondingly supported and operated blank. This mechanical method produces a satisfactory duplicate; but a single master-record can be used only a limited number of times, making the cost of the duplicates proportionately large. The other method which is commonly practiced consists in electroplating a master-record, then by suitable means removing the master-record from the electroplate, which forms a cylindrical matrix, backing up the matrix and supporting it in a hot-water or steam warming-jacket, then putting a blank of the proper size within the cylindrical matrix, supporting it therein until it becomes slightly softened by the heat of the surrounding jacket, and then applying a mandrel or former to the softened blank and forcing it into intimate contact with the matrix-surface of the electroplate, and finally removing the electroplate-matrix with attached blank and cooling in a refrigerator to cause the blank to contract so that it may be removed from the matrix. This process also produces satisfactory results, but is a long and tedious process, requiring skilled labor, and although less expensive than the mechanical method this electroplating method is not altogether satisfactory.

My present invention is distinguishable from the above-described processes and the matrices and blanks produced thereby in that my process is a "wet" process or "dipping" process of producing sound-records and my matrices and records are formed in or upon films resulting from the evaporation of a solution of a suitable material.

Broadly considered, my improved process consists in first forming a duplicating-matrix by dipping a master-record in a solution of a suitable material or flowing the solution upon the master-record or otherwise bringing the solution (in a fluid or semifluid state) into intimate contact with the record, then removing the master-record from the matrix, and finally impressing a suitable material into the matrix or electroplating the film-matrix or dipping the matrix into a solution of a desired material or otherwise bringing the solution (in a fluid or semifluid state) into intimate contact with the matrix for the purpose of forming a record. The record so produced is detached from the matrix and may be mounted upon a suitable backing, if necessary, for strength. The duplicating-matrix may be used over and over again an unlimited number of times, as there is practically no wear upon it in making the records.

More specifically, my improved process consists, preferably, in forming a duplicate record by dipping the master-record in or otherwise coating it with a fluid solution of some suitable material, such as gelatin, then allowing the coated record to cool and dry, the gelatin or other suitable material forming a tough and elastic film-matrix upon the master-record, then breaking or otherwise removing the master-record from the matrix formed by the film of hardened gelatin or other material, then dipping the gelatin matrix into the fluid solution of a suitable material, such as celluloid, (or applying to the matrix a backing-sheet of celluloid paper or other material coated with celluloid solution or other impressible material,) then allowing the same to dry, and finally separating the celluloid-film record from the gelatin matrix and applying a suitable strengthing backing to it.

If desired, the celluloid duplicate may be employed as a master-record, from which duplicates are cut upon the ordinary blanks of commerce in the usual way with a mechanical duplicating-machine.

When the commercial water solution of gelatin is employed in the formation of the matrix from the master-record, it is necessary in making the duplicate record therefrom to employ a material which will not affect the gelatin—such, for instance, as an alcohol and ether solution of celluloid or an easily-fusible composition of wax and rosin. If the gelatin is rendered waterproof by the addition of bichromate of potash and exposure to the sun, many more materials—such as water-glass, plaster-of-paris, starch, and other material having water in their composition—become available for use in forming the duplicate records and the scope of the invention thereby greatly enlarged.

My invention consists, further, of the improved film matrix and the improved film-record formed from solutions of suitable materials, as hereinafter more particularly pointed out.

My invention consists of further features of improvement ancillary to the above-mentioned main features, and in order that my invention may be fully understood I will first describe the same with reference to the accompanying drawings and afterward point out the novelty with more particularity in the annexed claims.

In said drawings, Figure 1 is a longitudinal sectional view of a cylindrical master-record formed in the usual way upon a sound-recording machine. Fig. 2 is a similar view showing the master-record with its attached gelatin-film matrix formed by dipping the master-record in a fluid gelatin. Fig. 3 is a detail sectional view of the gelatin-film matrix detached from the master-record by breaking or otherwise removing the master-record. Fig. 4 is a similar view representing the gelatin-film matrix with the attached celluloid-film record formed by dipping the matrix in a solution of celluloid or otherwise forming the celluloid or other material therein. Fig. 5 is a detail view of a separated celluloid-film record. Fig. 6 is a similar view representing the film-record having a suitable backing fitted within it, the backing being shown as made of a suitable material molded into the film-record.

The original or master record 1, formed in the usual way upon a sound-recording machine, is dipped in a solution of gelatin to form a gelatin-film matrix 2 upon its record-surface. The record may be dipped a sufficient number of times to form a film of the desired thickness, the coating being allowed to cool and partly evaporate and dry between the dippings. The master-record, with attached film-matrix 2, is then put aside to dry for about twelve hours, when the film of gelatin will assume a hard horny aspect. The film-coated master-record is then taken in the hand and with a steel bar or other suitable instrument is given two or three sharp blows to crack the master-record within the film-matrix, when the pieces of the master-record will readily fall out, leaving a film-matrix with a perfect clear-cut negative record upon its inner surface. The film-matrix 2, formed as just described, is then taken and dipped in a solution of suitable material, such as celluloid, it being dipped a sufficient number of times to produce a film-record 3 of the proper thickness. This coated matrix is then allowed to dry, and the celluloid-film record 3 will be readily detachable from the matrix. In making the solution of celluloid for producing the film-record I may add a proper quantity of a suitable material to cause the solution to contract in drying, so as to cause the film to be separated from the matrix and facilitate its removal.

In place of dipping the film-matrix in a solution of celluloid I may take a sheet of celluloid and coat its surface with a celluloid solution and impress the surface coated with the semifluid material against the matrix-face of the film-matrix, the jointed ends of the celluloid sheet being cemented by the celluloid solution and the ridge or uneven portion of the joint pressed out against the matrix. The matrix, with celluloid impressed upon, it is then allowed to dry, and the evaporation or drying out of the alcohol and ether of the celluloid solution forms a vacuum between the celluloid sheet and matrix and causes the celluloid to closely adhere to the matrix and faithfully reproduce the record thereof. When the celluloid and its film-coated surface have become perfectly dry, so as to form practically an integral cylindrical record within the matrix-cylinder, I separate the celluloid record from the matrix by bending the celluloid record inwardly away from the matrix at different points and then partially collapsing the record to allow it to be withdrawn from the matrix. This bending and collapsing of the celluloid record within the matrix does not injure the record, because of its elastic nature.

In place of the use of celluloid for the record I may employ a mixture of beeswax and rosin. The ordinary record of commerce is made up of stearic acid, aluminium or a suitable salt of aluminium, and caustic potash fused together into an intimate mass, which is molded into the desired shape. This material has a very high melting-point and could not be molded in a matrix of gelatin formed according to my process, as the heat of the material in a fluid state would melt the record upon the gelatin matrix. I have discovered that a mixture of rosin and beeswax can be kept in fluid state at a very low temperature—lower, in fact, than the beeswax alone—and as the rosin tempers the wax and removes its objectionable viscous quality I am able to form a very satisfactory record of this material. The mixture of rosin and beeswax in about equal proportions is flowed into the gelatin-film matrix or the matrix is dipped into the fluid mixture and the mixture forms upon the matrix, as in the use of the semifluid solution of celluloid. The beeswax-and-rosin record is allowed to dry and harden, and in drying it contracts and separates from the film-matrix and can readily be removed.

If desired, a suitable paper backing may be coated with a film of celluloid or other suitable record-forming solution and the semifluid film-surface impressed against the matrix to form the phonographic record. The paper backing may be in any preferred shape to suit the machine for which the record is prepared.

Any other material suitable for the body of the record may be covered with the impressible fluid or semifluid material and a record impressed upon it, as above described, without departing from the spirit of my invention.

One disadvantage in the use of the ordinary commercial solution of gelatin in forming the matrices is that the gelatin is soluble in water, and therefore materials having water in their composition cannot be employed to form the records. To avoid this objection, I propose to render the gelatin solution waterproof by mixing with the solution a suitable quantity of bichromate of potash and then exposing the mixture to the sun. As is well known, this will produce a waterproof gelatin solution. With the matrix formed of this waterproof gelatin it is possible to use many materials, such as silicate of soda, plaster-of-paris, starch, and other materials which contain water. The waterproofing of the gelatin greatly broadens the scope of my invention, as many materials become available for making the records which could not otherwise be used.

The record formed as above described may or may not be of sufficient strength in itself to withstand the wear and tear to which a record is subjected. If the record is a mere film, as when made of celluloid solution, it is necessary to strengthen it by providing it with a suitable backing. This backing may be a properly-shaped paper form or it may be plaster-of-paris or other material 4, molded into the film-record around a suitable mandrel or former. In Fig. 6 I have shown the film-record upon a backing 4 of molded material, such as plaster-of-paris.

It will of course be understood that I do not limit myself to any particular shape of record, my invention being equally applicable for making a cylindrical or a flat record.

In using the term "dipping" I mean to cover flowing the fluid coating material upon the matrix or record surface, immersing the matrix or master-record in the coating material, or otherwise covering the matrix or record surface with the impressible fluid or semifluid material.

As above stated, the record may be made from the film-matrix by electroplating in the usual well-known way without departing from the spirit of my invention.

I would have it understood that those claims employing such expressions as "bringing a solution of a suitable material into contact with the matrix (or record) surface" are intended to cover the use of a suitable material in any impressible state, whether fluid or semifluid and whether the material is applied direct to the matrix or record or is first applied to a backing or body material and afterward brought into contact with the matrix or record.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. The herein-described process of producing sound-records, which consists in forming a matrix of the desired record, then coating the matrix with a solution of a suitable material to form thereon a film-record, and finally separating the film-record from the matrix, as set forth.

2. The herein-described process of producing sound-records, which consists in forming a matrix of the desired record, then dipping the matrix in a solution of a suitable material, then allowing the coated matrix to dry to form upon the matrix a film-record, and finally separating the film-record from the matrix, substantially as set forth.

3. The herein-described process of forming matrices of sound-records, which consists in coating a master-record with a solution of a suitable material and allowing it to dry thereon to form upon the master-record a film-matrix, and then removing the master-record, as set forth.

4. The herein-described process of forming matrices of sound-records, which consists in dipping a master-record in a solution of a suitable material, allowing the coated master-record to dry, and finally removing the master-record from the film-matrix, substantially as set forth.

5. The herein-described process of duplicating sound-records which consists in coating a master-record with a solution of a suitable material and allowing it to dry to form upon the master-record a film-matrix, then removing the master-record from the film-matrix, and finally forming a suitable material in the film-matrix and removing the matrix from the duplicate record thereby produced, substantially as set forth.

6. The herein-described process of duplicating sound-records, which consists in dipping or flowing a suitable coating material upon a master-record, allowing the same to dry and harden upon the record, then removing the master-record from the matrix thus formed, and finally forming a duplicate record in or upon the matrix, substantially as set forth.

7. The herein-described process of duplicating sound-records, which consists in dipping a master-record in a solution of a suitable material, thereby forming a film-matrix upon the master-record, next removing the master-record from the film-matrix, then dipping the film-matrix in a solution of suitable material

to form a film-record thereon, then separating the film-record from the matrix, substantially as set forth.

8. The herein-described process of duplicating sound-records, which consists in dipping a master-record in a solution of gelatin and allowing it to dry, thereby forming a film-matrix upon the master-record, next breaking or otherwise removing the master-record from the film-matrix, then dipping the film-matrix in a solution of celluloid and allowing it to dry, forming a film-record upon the matrix, then separating the film-record of celluloid from the matrix, substantially as set forth.

9. The herein-described process of duplicating sound-records, which consists in dipping a master-record in a solution of gelatin and allowing it to dry, thereby forming a film-matrix upon the master-record, next breaking or otherwise removing the master-record from the film-matrix, then dipping the film-matrix in a solution of celluloid and allowing it to dry, forming a film-record upon the matrix then removing the film-record of celluloid from the matrix, and finally mounting it upon a suitable backing, substantially as set forth.

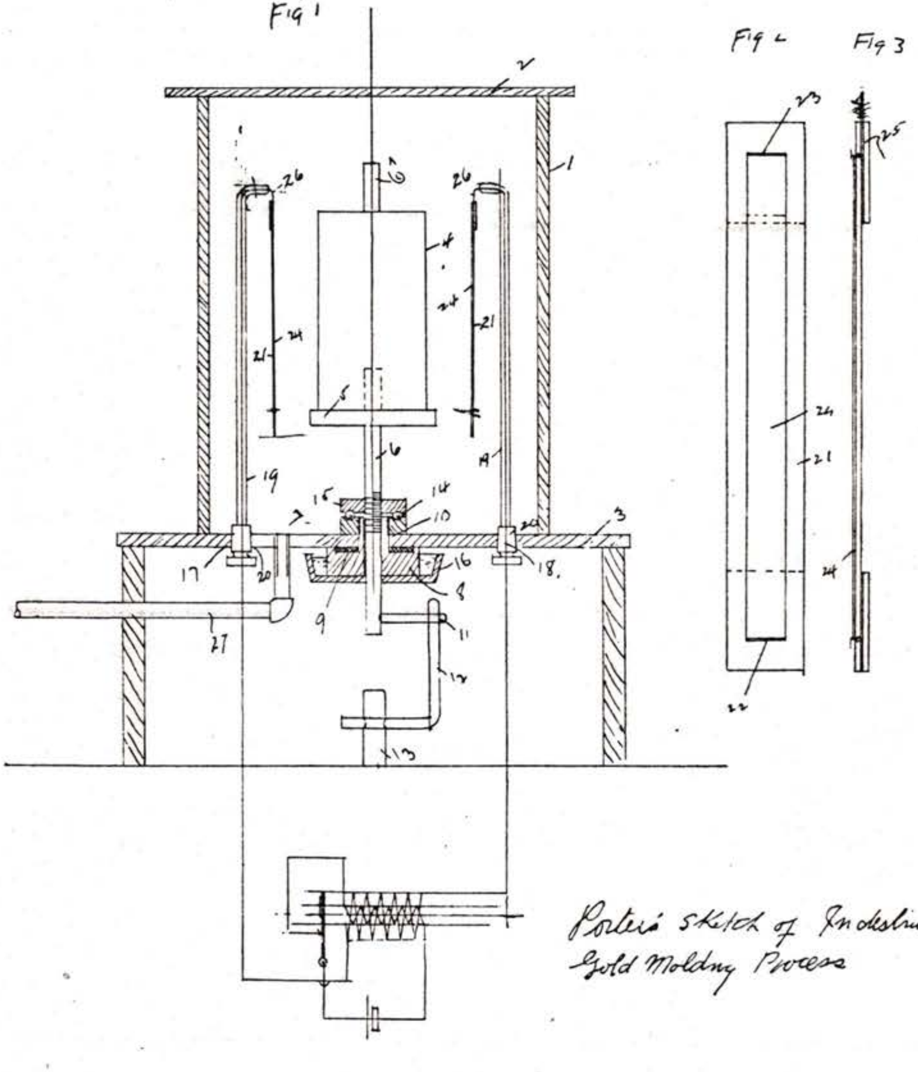
10. The herein-described process of duplicating sound-records which consists in dipping a master-record in a waterproof solution of gelatin, then removing the master-record from the film-matrix formed upon the same and finally forming a duplicate record in the waterproof gelatin matrix and removing the record thus formed from the matrix, substantially as set forth.

11. As an article of manufacture, a sound-record consisting of irregularities corresponding to sound-waves, the same being molded upon a horny surface formed by the evaporation of a solution upon a suitable matrix-surface, substantially as described.

FRANK L. CAPPS.

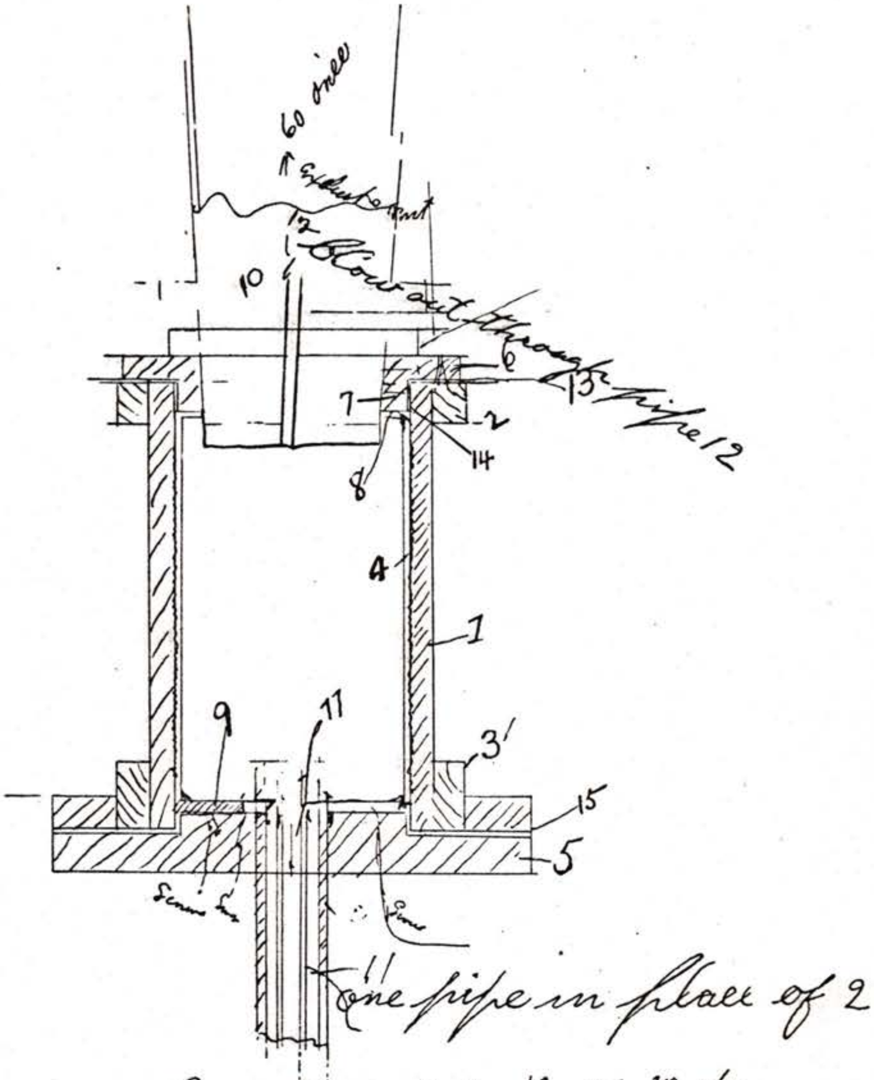
Witnesses:
A. B. C. SALMON,
N. CARTER.

"Complainants' Exhibit Porter Sketch of Gold-Moulding Apparatus."



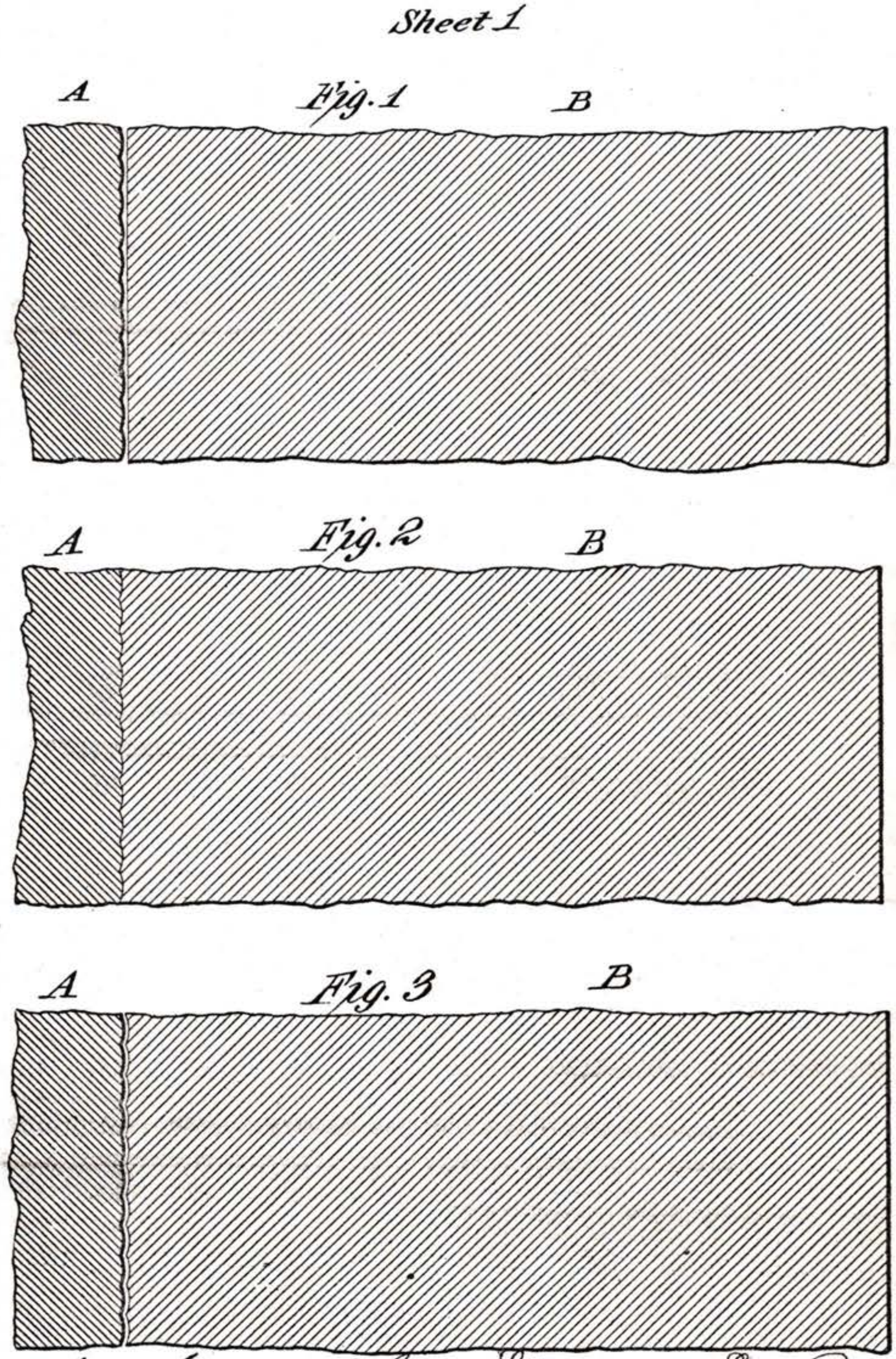
Porter's sketch of Indestructible Co
Gold Molding Process

"Complainants' Exhibit Drawing of Defendants' Apparatus."



Messer Sketch of Indestructible Co. Printing Machine.

Complainants' Exhibit, Diagram Edison Process.



U.S. Circuit Court,
Northern District of Illinois,
Northern Division

National Phonograph Co. Complt.
vs.
Lambert Company, Deft.

In Equity
No. 26,598.

"Complts' Exhibit Diagram Edison Process."

D.F.R.
N.P. Spl Ex'r

Complainants' Exhibit, Diagram of Defendants' Process.

Sheet 2

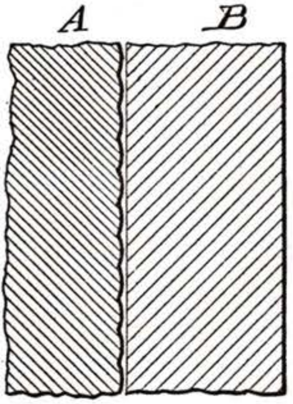


Fig. 1

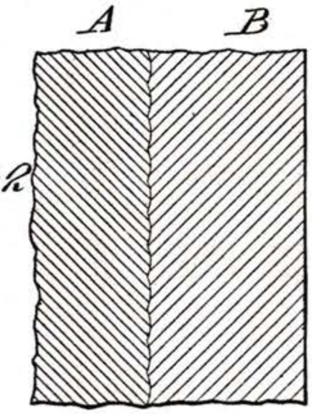


Fig. 2

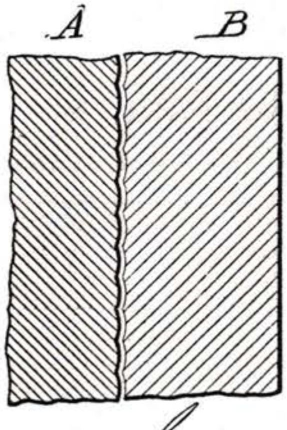


Fig. 3

U.S. Circuit Court,
Northern District of Illinois,
Northern Division

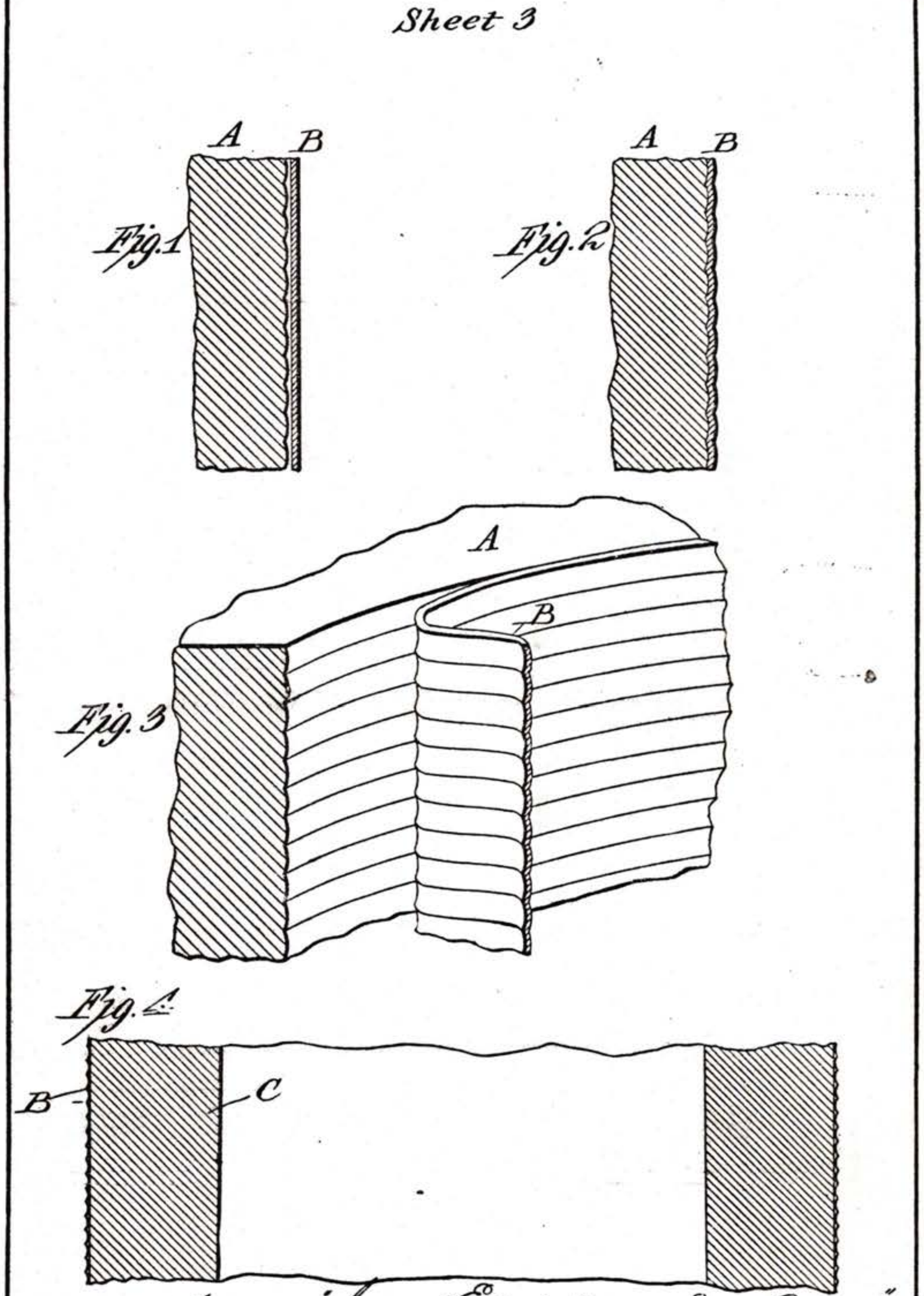
National Phonograph Co., Complts.
vs
Lambert Company, Deft.

In Equity
No 26,598

Complts' Exhibit Diagram
"Defendants' Process"

J.F.R.
N.P. & Spl. Exr.

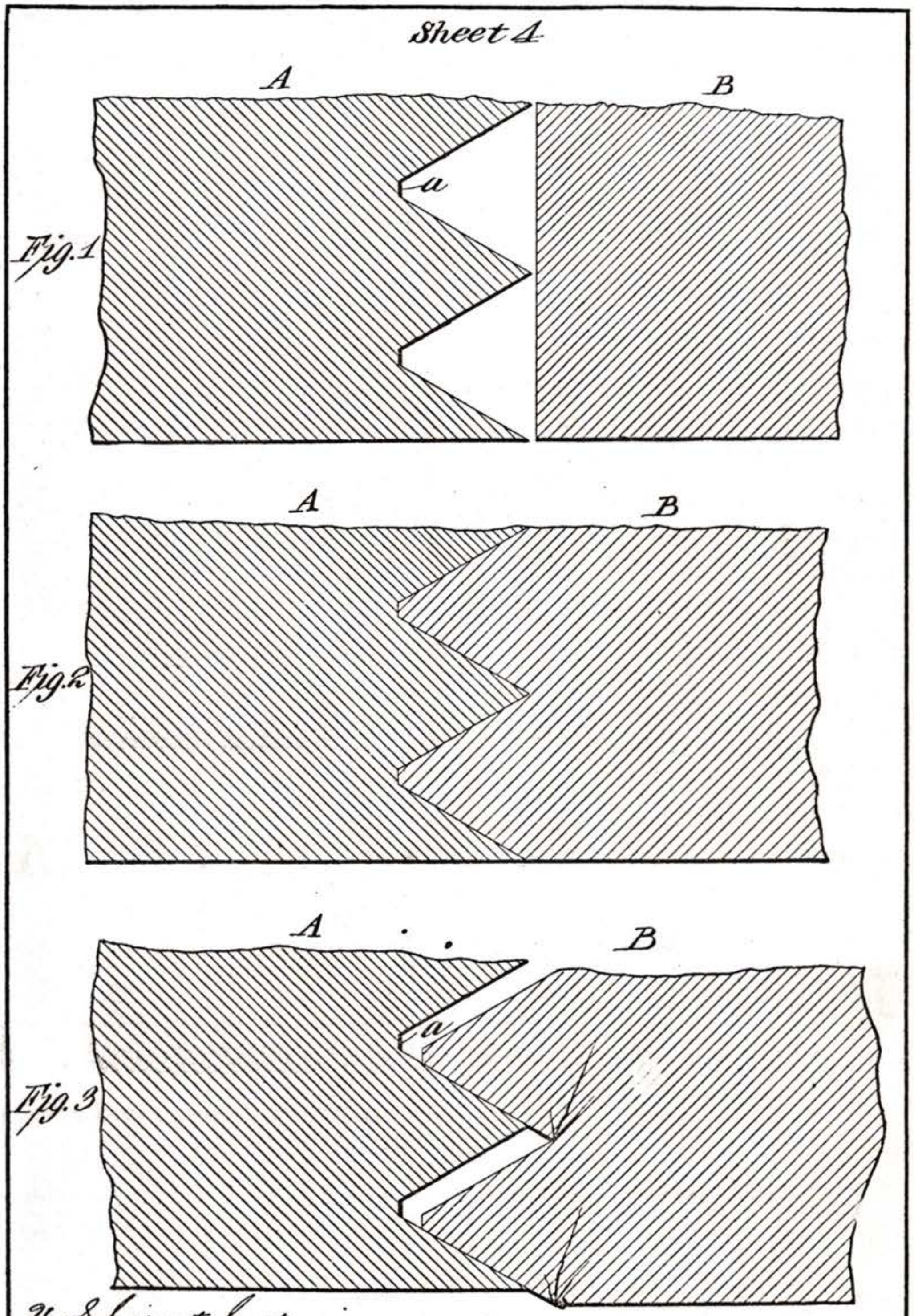
Complainants' Exhibit, Diagram of Young Process.



"Complts' Exhibit Diagram Young Process."
J.F.R.
N.P. [illegible] Ex'r

U.S. Circuit Court,
Northern District of Illinois,
Northern Division
National Phonograph Co. Compl't
vs
Lambert Company Deft
} In Equity
No. 26,598

Complainants' Exhibit, Diagram Lioret Process.



U. S. Circuit Court
Northern District of Illinois
Northern Division
National Phonograph Co.
Complt.
vs
Lambert Company
Deft.

In Equity.
No. 26598

"Complainants' Exhibit Diagram Lioret Process"
J. T. R.
N.P. & Spl. Exr.